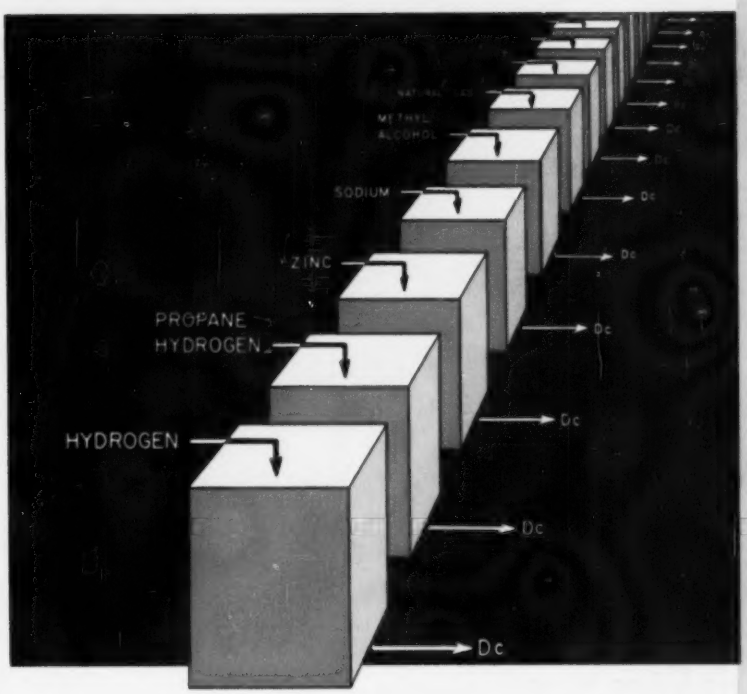
A McGRAW-HILL PUBLICATION **NOVEMBER 1960**

ONE DOLLAR

Power

the magazine of energy systems engineering



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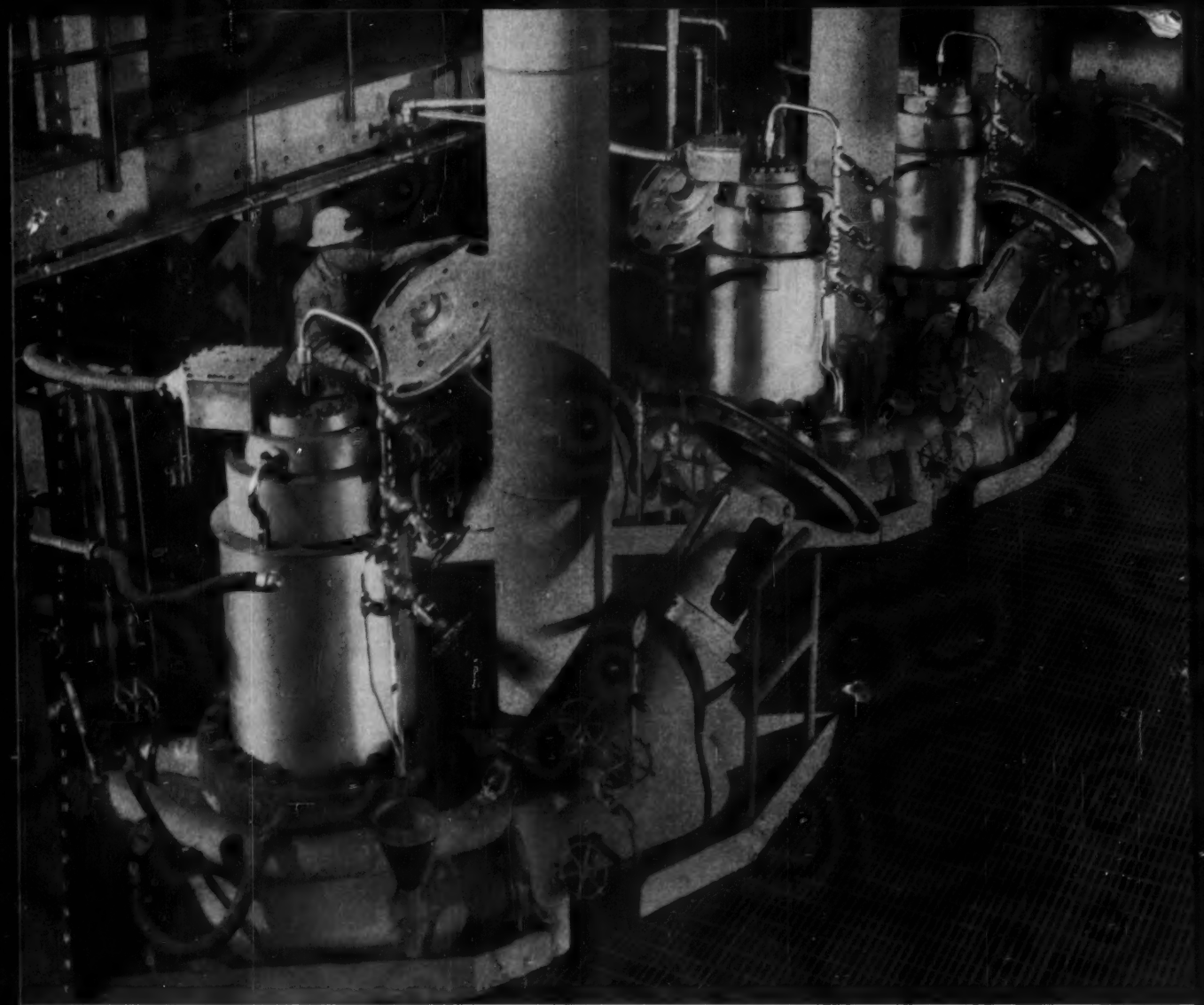
For more facts circle 201 on Reader Service card, p 103



At Penelec's Shawville Station three of six Westinghouse "canned" motor-pumps operating at 7950 gpm, 651° F, 2637 psi suction.

Westinghouse "canned" motor-pumps chosen again by Penelec

Pennsylvania Electric Company has again installed Westinghouse "canned" motor-pumps on its controlled circulation boilers at its Shawville Station. This time, Gilbert Associates and Penelec installed these pumps on Shawville units #3 and #4 because of the excellent, trouble-free service record of similar pumps at Penelec's Seward Station.

Reasons behind the excellent pump operating experience: (1) pump and motor casings completely enclose pump shafting, eliminating troublesome shaft seals and power-consuming seal-injection systems; (2) watertight Inconel cans keep stator windings dry and trouble-free; (3) proven water-lubricated bearings assure maximum reliability and minimum maintenance.

For details on how Westinghouse "canned" motor-pumps can give you long-term, reliable service and boost controlled circulation boiler efficiency, call your Westinghouse sales engineer. Or write: Westinghouse Electric Corporation, Atomic Equipment Department, P. O. Box 217, Cheswick, Pa. You can be sure . . . if it's Westinghouse. J-57024

Westinghouse

For more facts circle 204 on Reader Service card, p 103

speaking of **Power**

This issue contains two articles dealing in areas where there is lack of agreement on a basic definition. In each POWER had a hand in proposing what might prove an acceptable solution.

Fuel cells are subject of this month's *TD* report. This area is marked by a conspicuous difference of opinion on just what constitutes a fuel cell. Apparently all agree they are electrochemical devices with a low-voltage dc output. Differences arise in defining the fuel input and whether or not that fuel source must be continuous. For our suggested definition, see p 60.

Voltage nomenclature—that is, system voltage within an industrial plant or commercial building—is another area where opinions differ. The only existing guide for system-voltage designation is oriented toward the electric utilities.

Typical problem arises when attempting to designate the nominal voltage on output side of a secondary substation. Many have identified this area of the system with a 480-volt nominal label just because the transformer secondary carries a 480-volt rating. This sounds entirely logical on the surface, but presents some real problems when upper and lower voltage limits are cranked in.

Fully aware of need for industry-wide agreement on labeling the many voltage classifications in use, a working group within AIEE's Industrial & Commercial Power Systems Committee—GE's Brereton, Bisson of Con Ed, Donnelly of New York Telephone, Westinghouseman Lawrence, Peach of POWER—wrestled with the problem. Last month, during AIEE Fall Meeting in Chicago, the group came up with its recommendations.

For key points of these recommendations, see Associate Editor Norm Peach's timely article on voltage nomenclature, pp 78-79 of this issue.

Lon Lowley

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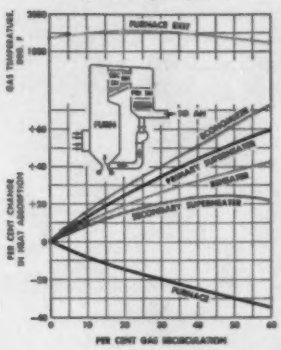
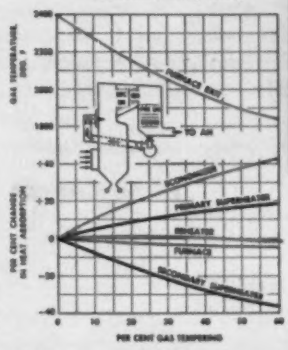
EFFECT OF GAS CONDITIONING

Effect of Gas Recirculation in Hopper
(Constant Firing Rate)



Effect of Gas Tempering at Furnace Exit
(Constant Firing Rate)



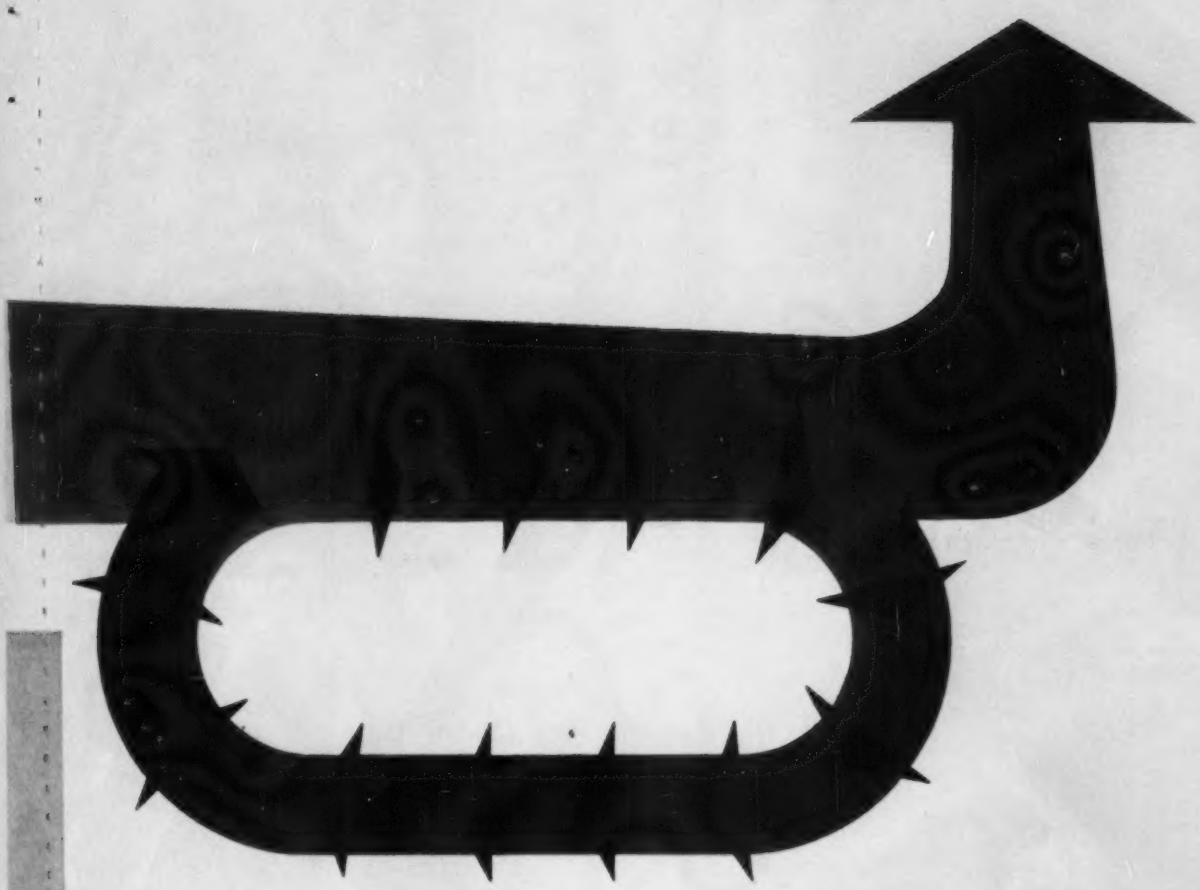
B&W GAS

B&W engineering concept tempers furnace exit gases and controls absorption patterns for improved design, operating and maintenance characteristics

Just as the heating and cooling systems in your home condition air to provide a moderate, healthful atmosphere under the "load" of varying climate . . . B&W Gas Conditioning provides moderated, balanced gas temperature in the boiler under varying conditions of load, changes in fuel characteristics, and varying cleanliness of heat absorption surfaces.

Gas Conditioning is the composite use of "cool" flue gases recirculated either to reduce gas temperature at the furnace exit (gas tempering) or to control heat absorption relationships between the furnace and the superheater-reheater surfaces (gas recirculation).

Increasing load normally brings up gas temperature,



CONDITIONING

however, Gas Conditioning introduces proportioned flue gas to "temper" furnace exit gas to maintain desired temperature. This greatly reduces ash fouling, corrosion and creep of tube surfaces in the superheater, guards against enameling of ash on superheater tubes, and permits a significant reduction in the high alloy requirements.

As load decreases, Gas Conditioning recirculates proportioned flue gas through the furnace, controlling furnace heat absorption and thereby maintaining constant steam temperatures for efficient performance.

B&W GAS CONDITIONING has been soundly proved in operation, and deserves serious consideration in any discussion of new boiler design. Additional information and case history data are available on request. The Babcock & Wilcox Company, Boiler Division, Barberton, Ohio.

G-968

B&W

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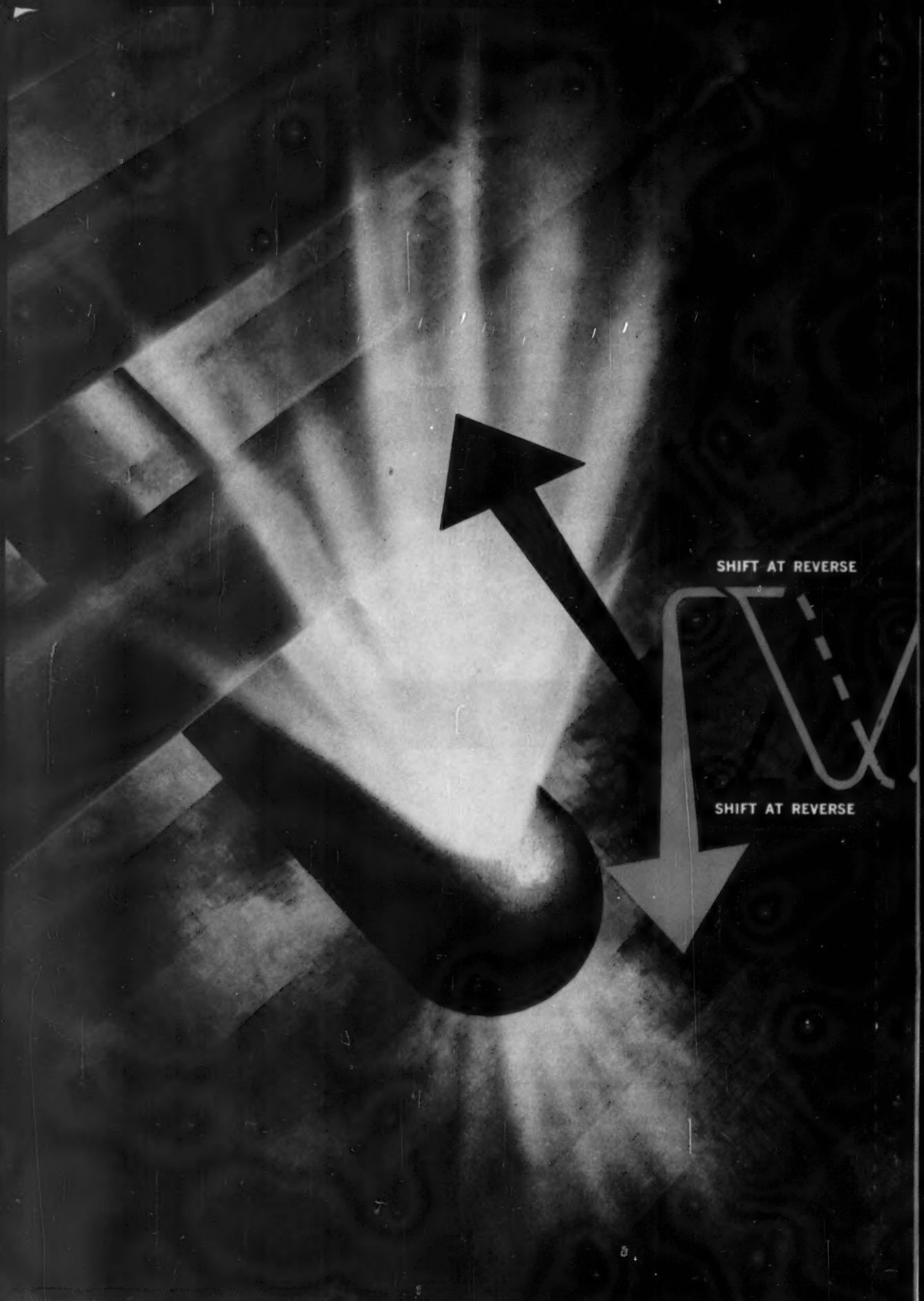
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Get uniform, complete cleaning in those "tough-to-clean" zones. Specify Diamond's IK-300 Retractable Blower. The exclusive close-spaced IK helix assures a penetrating nozzle sweep every inch of travel regardless of tube bank arrangement and tube spacing. What's more, because sectionalized lance tube construction cuts deflection to a minimum, smaller boiler cavities are possible. In addition, a unique method of equalizing nozzle end-thrust assures "minimum-wobble" travel regardless of distance.

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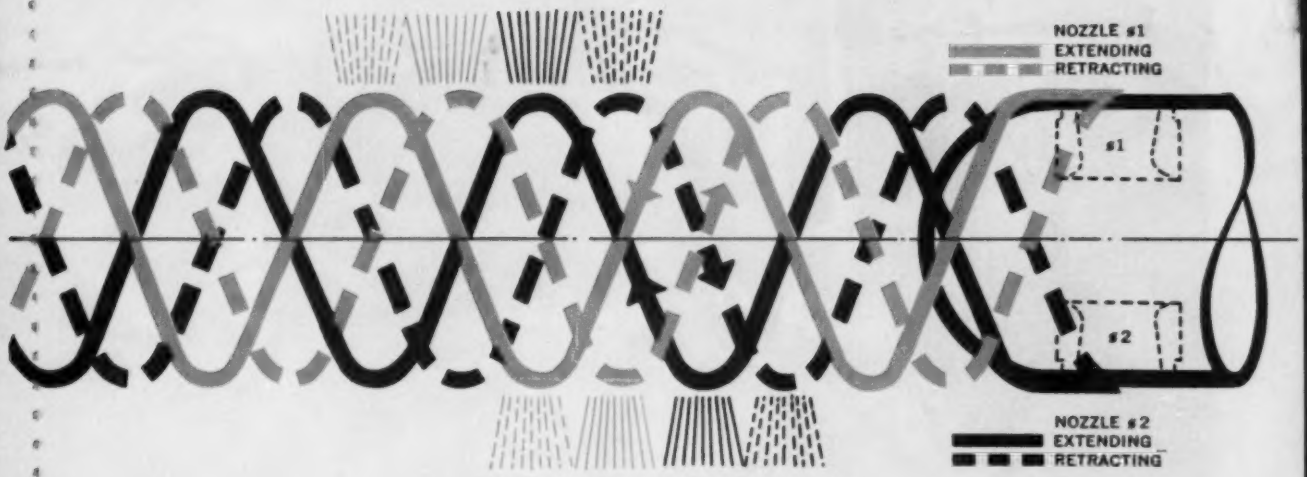

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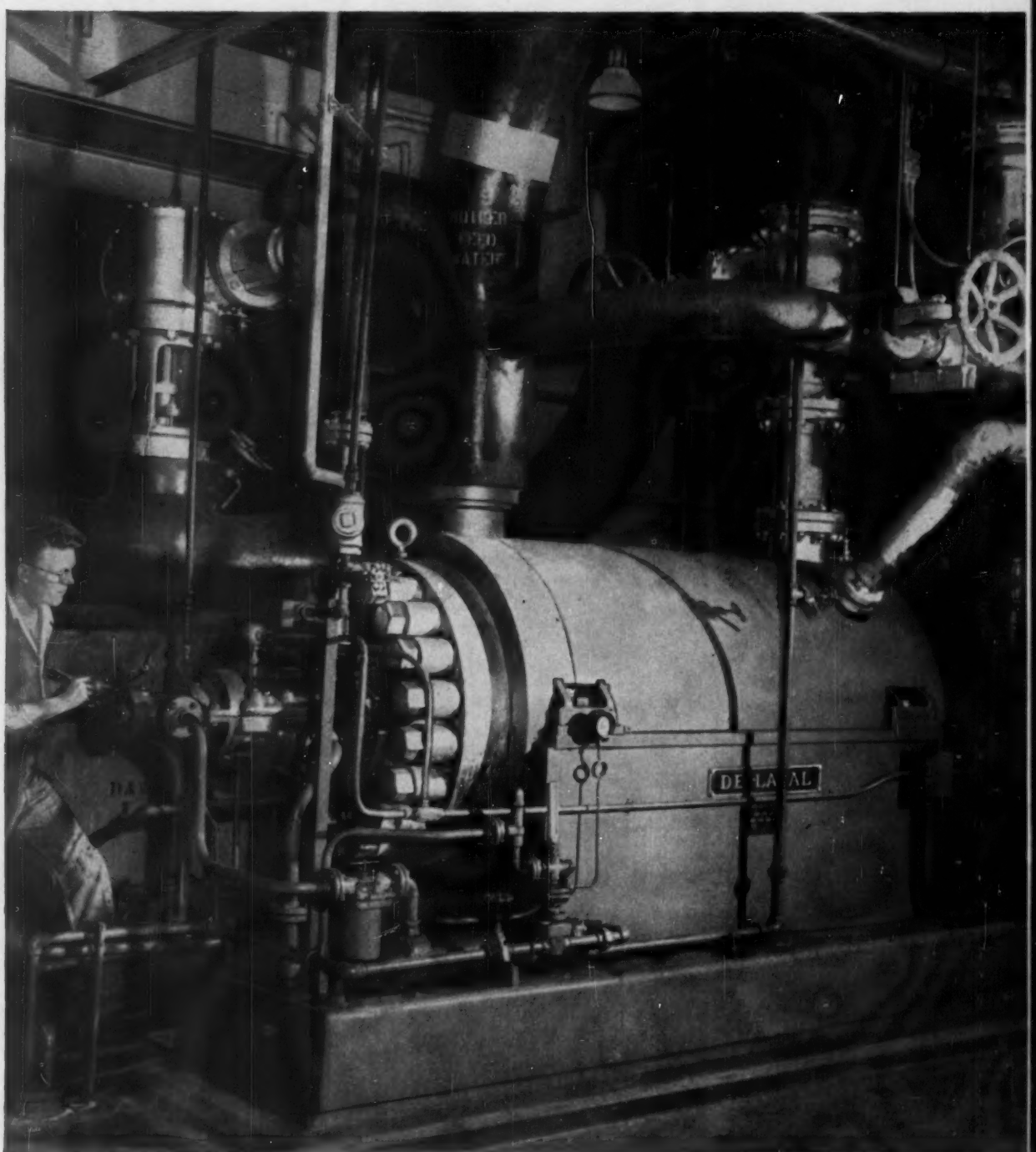


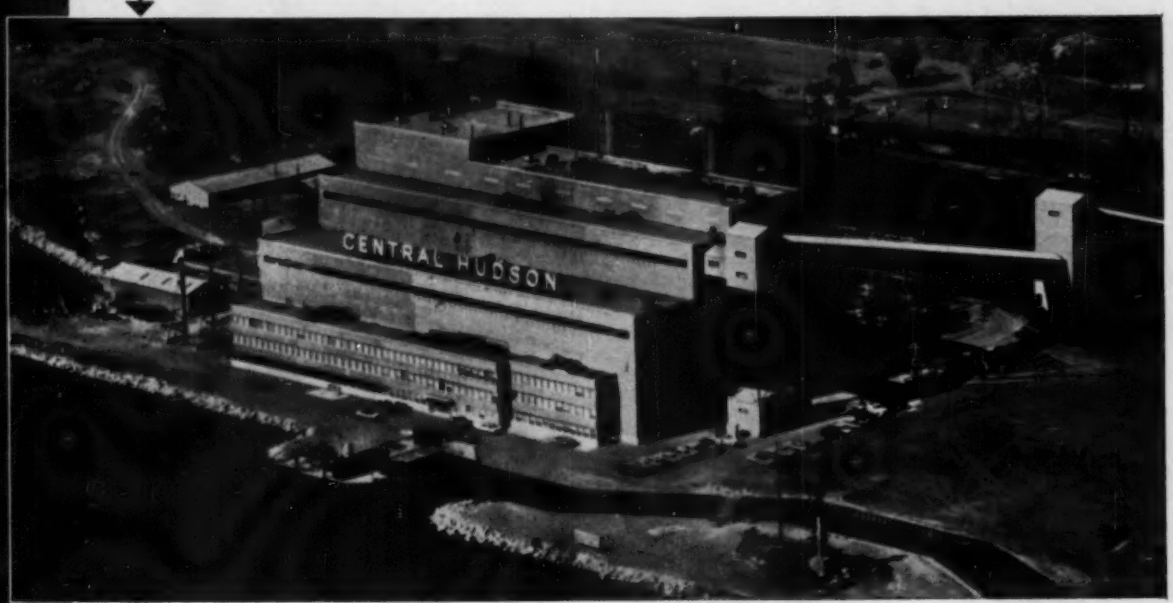
latest unit at Central Hudson

Burns and Roe Inc., Engineers and Constructors, complete third unit at Danskammer Station

To meet increased load demand, Central Hudson Gas & Electric Corporation has added a 140,000 KW 2400 psig main unit at its modern Danskammer Steam Station. Providing dependable boiler feed service are two 2500 HP direct motor driven half capacity De Laval barrel type boiler feed pumps. The earlier units have De Laval full capacity variable speed boiler feed pumps.

← Each De Laval pump has intermediate pressure bleed off for use in controlling steam temperature from reheater.

Central Hudson's modern Danskammer Steam Station located at Roseton, New York on the Hudson River. ↓



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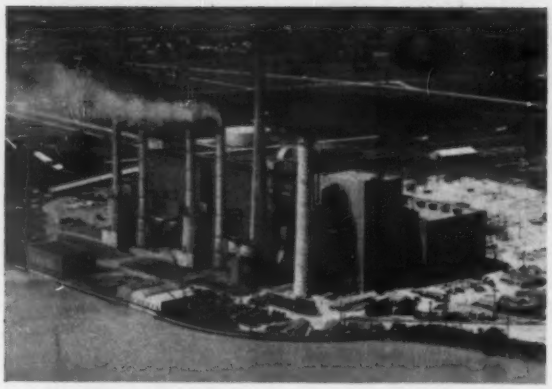
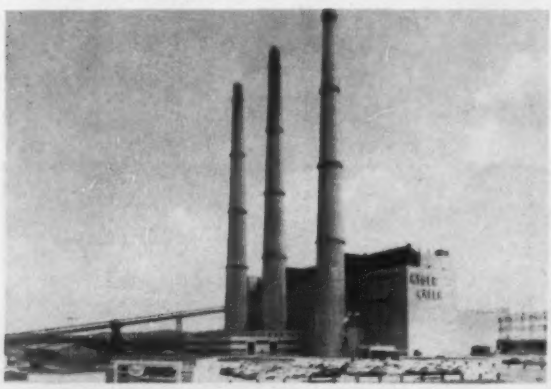
FPC's list of "most" finds Bailey users

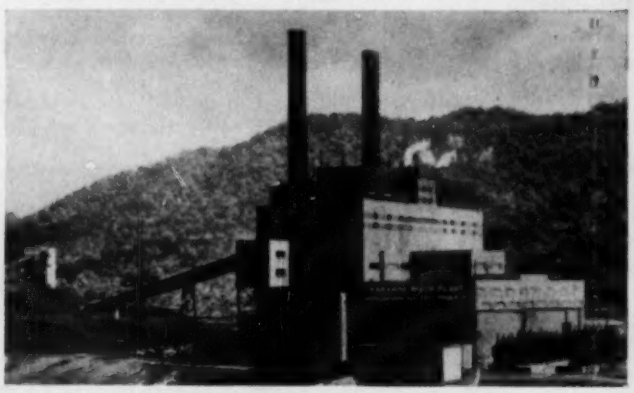


ST. CLAIR (The Detroit Edison Co.)—top 11, 1954-1958, averaging 9222 Btu/kwhr.

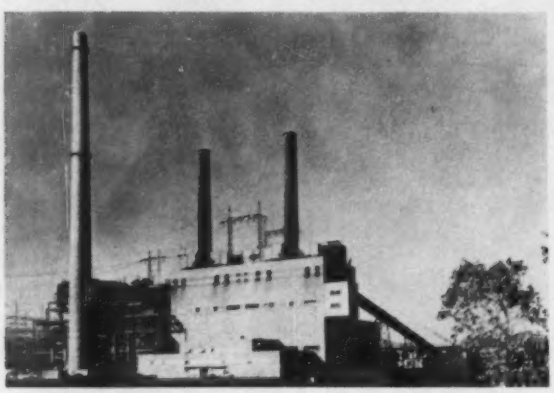
TANNER'S CREEK (Indiana & Michigan Electric Co.)—top nine, 1954-1958, first in 1956, averaging 9204 Btu/kwhr.



KYGER CREEK (Ohio Valley Electric Corp.)—top six, 1955-1958, first in 1955, averaging 9164 Btu/kwhr.



KANAWHA RIVER (Appalachian Power Co.)—top three, 1954-1958, first in 1954 and 1957, averaging 9128 Btu/kwhr.



MUSKINGUM RIVER (Ohio Power Company)—top five, 1954-1958, averaging 9216 Btu/kwhr.

BAY SHORE (The Toledo Edison Co.)—top ten, 1956-1958, averaging 9241 Btu/kwhr.

efficient plants"
as consistent repeaters

Thirteen of the 15 most efficient power plants on the Federal Power Commission's 1958 list use Bailey Meters and Controls.

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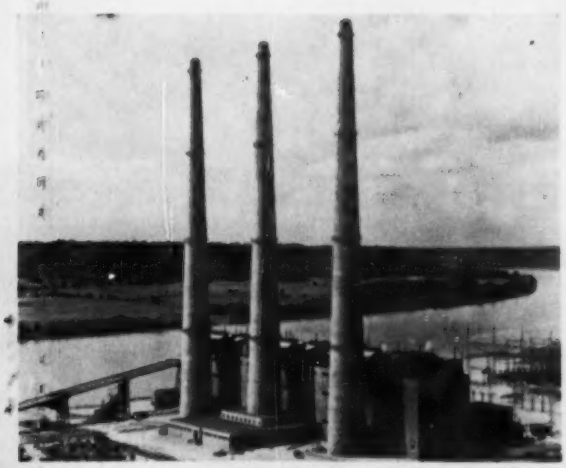
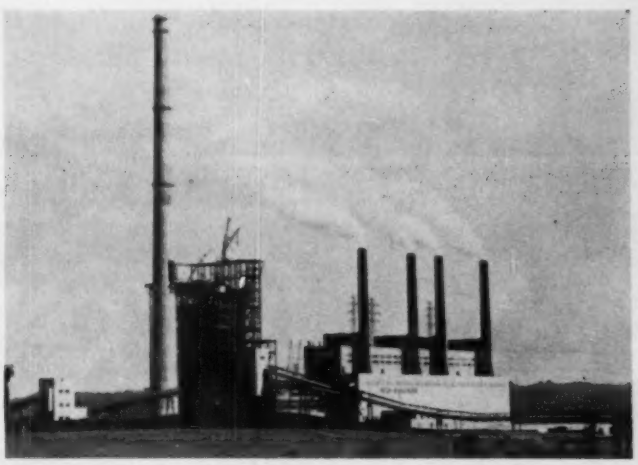


CLIFTY CREEK (Indiana-Kentucky Electric Corp.)—top five, 1955-1958, averaging 9155 Btu/kwhr.



PHILIP SPORN (Appalachian Power Co.—Ohio Power Co.) —top fifteen, 1954-1958, averaging 9378 Btu/kwhr.

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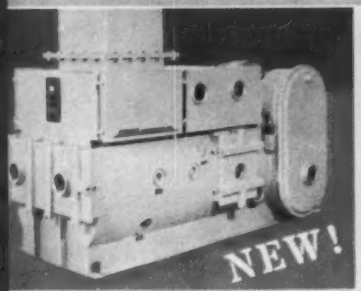
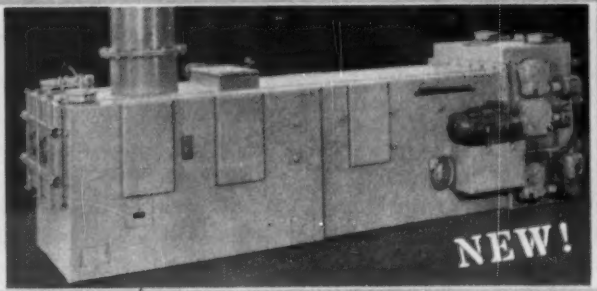
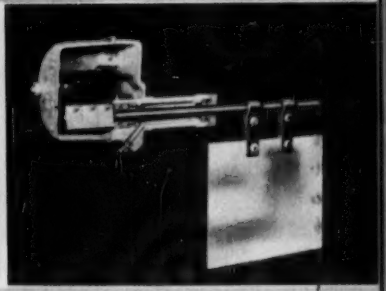


GRAVIMETRIC FEEDERS
Weigh and Feed



VOLUMETRIC FEEDERS
Feed Sticky Coals



STOPPAGE ALARMS
Two Types

STOCK EQUIPMENT COMPANY

CONICAL Non-Segregating COAL DISTRIBUTORS Eliminate Segregation

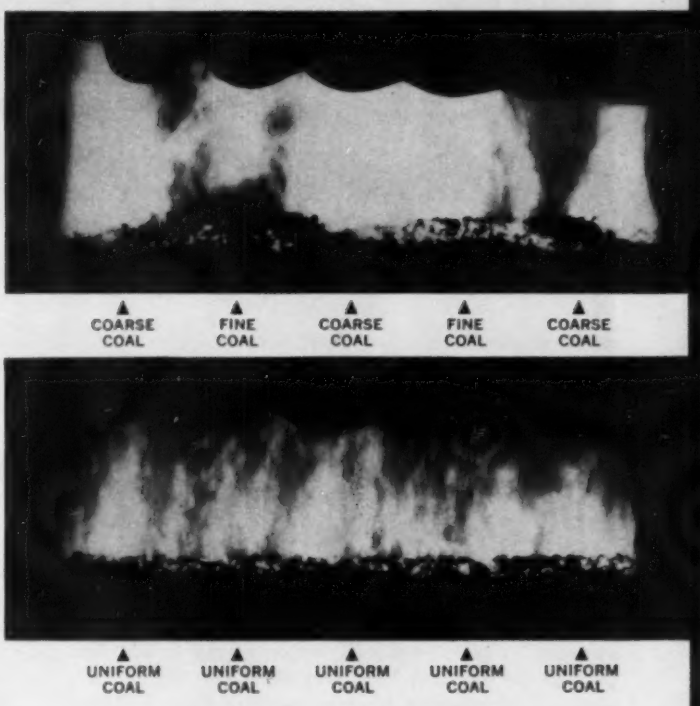
here is proof:

BEFORE

Illustration of the fire on a chain grate stoker that is equipped with two flat chutes. Note the two fine coal zones with the attendant smoke and fuel going to the ash pit. Also note three coarse coal zones where the CO_2 is low and where the uncovered stoker iron is exposed to high furnace temperatures.

AFTER

This photograph shows the same stoker after it was equipped with two S-E-Co CONICAL Non-Segregating Coal Distributors. Note that the uniform coal feed produces a fire which is burning uniformly across the entire stoker, thus producing uniformly high CO_2. Also note that the fuel is thoroughly burned out before the ashes are dumped into the ash pit.



S-E-Co. CONICAL Coal Distributors deliver coal to stokers without segregation. Non-Segregated coal feed assures a uniform fire with high average CO_2, and produces an ash low in combustible. A uniform fire makes possible increased boiler rating. Maintenance of arches and stoker iron is decreased.

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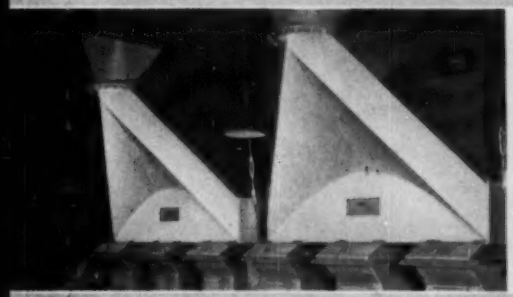
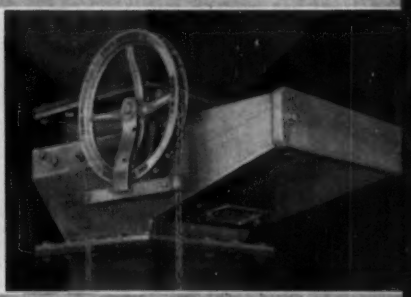
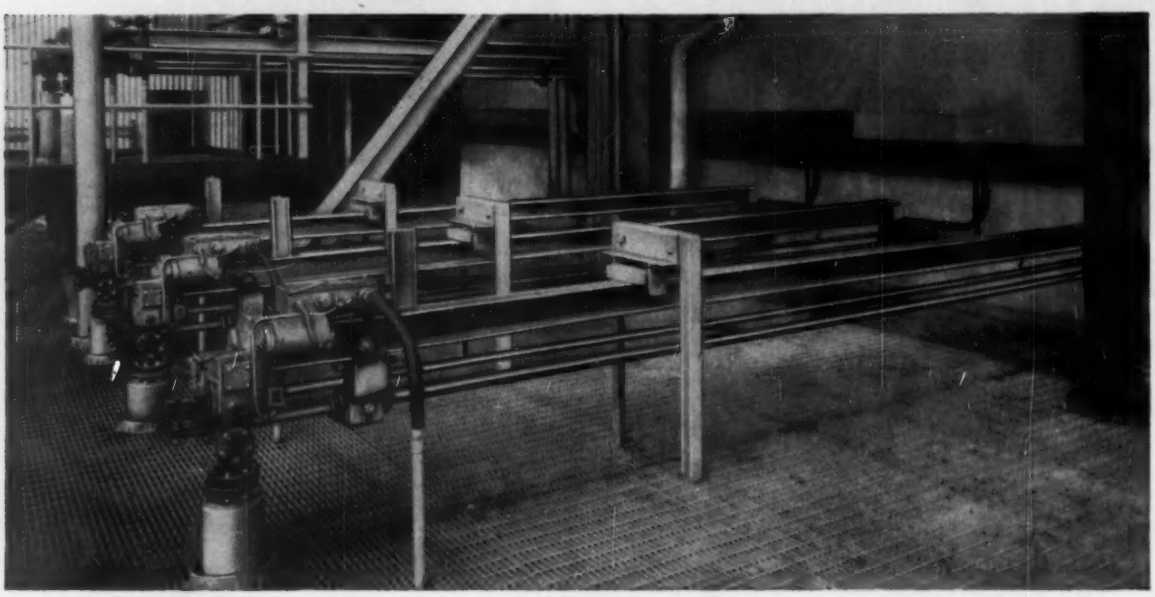


CONICAL NON-SEGREGATING COAL DISTRIBUTORS

COAL SCALES
Two Basic Sizes



COAL VALVES
6" to 60" — Many Styles



Vulcan Automatic-Sequential System controls soot blowing at new Gannon Station

As the first modern utility boiler in Florida to be fired by coal, Tampa Electric Company's Gannon Station incorporates the most advanced control systems. Unit 1, with its boiler rating at 950,000 pounds per hour at 1760 psig and 1000 degrees F., uses a Vulcan soot blowing system that features both group and unit control.

Vulcan T-3-E long retractable soot blowers with their dual-motor drives clean Gannon's Unit 1 boiler with double-helix patterns for complete coverage. The system includes Vulcan wall deslaggers and rotary soot blowers—all driven by electric motors and using steam as the blowing medium.

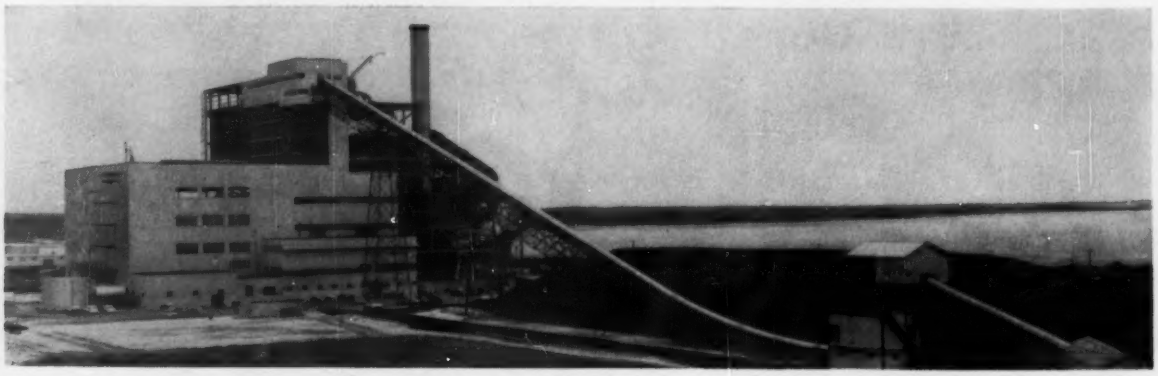
A Copes-Vulcan diaphragm valve reduces steam pressure for blowing and a Copes-Vulcan motor-operated valve is used for shut-off.

A similar Vulcan system will be installed on Gannon's Unit 2, rated at 950,000 pounds per hour at 1760 psig and 1000 degrees F.

Copes-Vulcan offers complete systems for controlling combustion, feedwater, boiler feed pump recirculation, steam temperature, and soot blowing. Whether your boiler is large or small, power or process, Copes-Vulcan can provide a unit or an integrated package, custom designed to your needs. For details, write Copes-Vulcan Division, Erie 4, Pa.

Copes-Vulcan Division

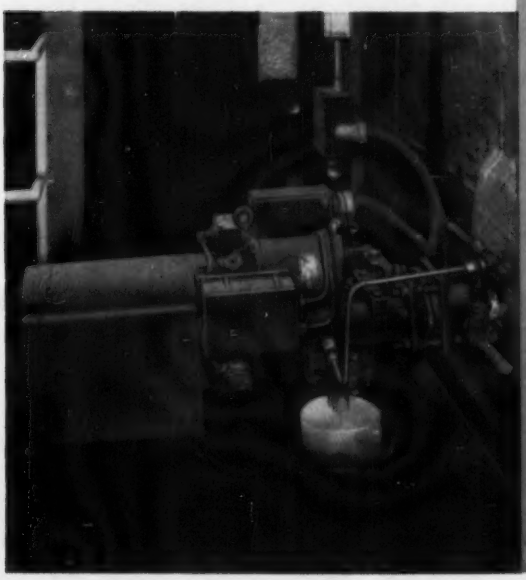
BLAW-KNOX

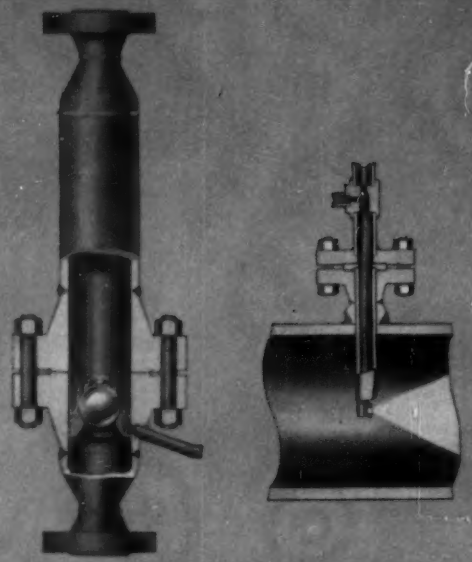


C-V NEWS NOTES

Finger tip control for Gannon's operators . . . with Vulcan's Automatic-Sequential group and unit control. Operator can preselect any number of soot blowers for automatic sequence . . . preselect any number of units or groups of units to be operated individually . . . or switch instantly to single unit operation. Program lights and toggle switches are located on engraved boiler diagram. Automatic-Sequential systems use steam, air or a combination as the blowing medium without a change in equipment. Write for Bulletin 1029.

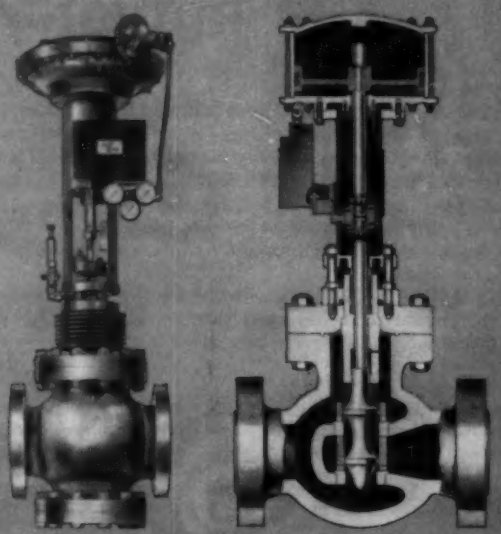
Wall deslagger conserves steam . . . minimizes average slag thickness. Vulcan's RW-3E is equipped with dual motors: one to traverse fast to get the nozzle to and from the blowing position almost instantly . . . the other to rotate the tube slowly for thorough cleaning. The RW-3E may be installed indoors or out, at almost any angle from side wall, roof or floor. It has only one outside stuffing box, no threads or working parts in the blowing medium to assure easy maintenance. Write for Bulletin 1034.





Desuperheaters improve temperature control. Variable-Orifice Desuperheater* (left) uses a weighted steel ball to control orifice opening . . . holds reduced steam temperature constant only twenty feet downstream from desuperheater outlet, even over a 50-to-1 load range. Bulletin 1037. *Patent Applied For

Steam-Assist (right) meets all specifications for conventional steam-atomizing type yet normally uses assisting steam only on light loads where control is most difficult. Mechanical-atomizing types also available. Bulletin 1024-A.

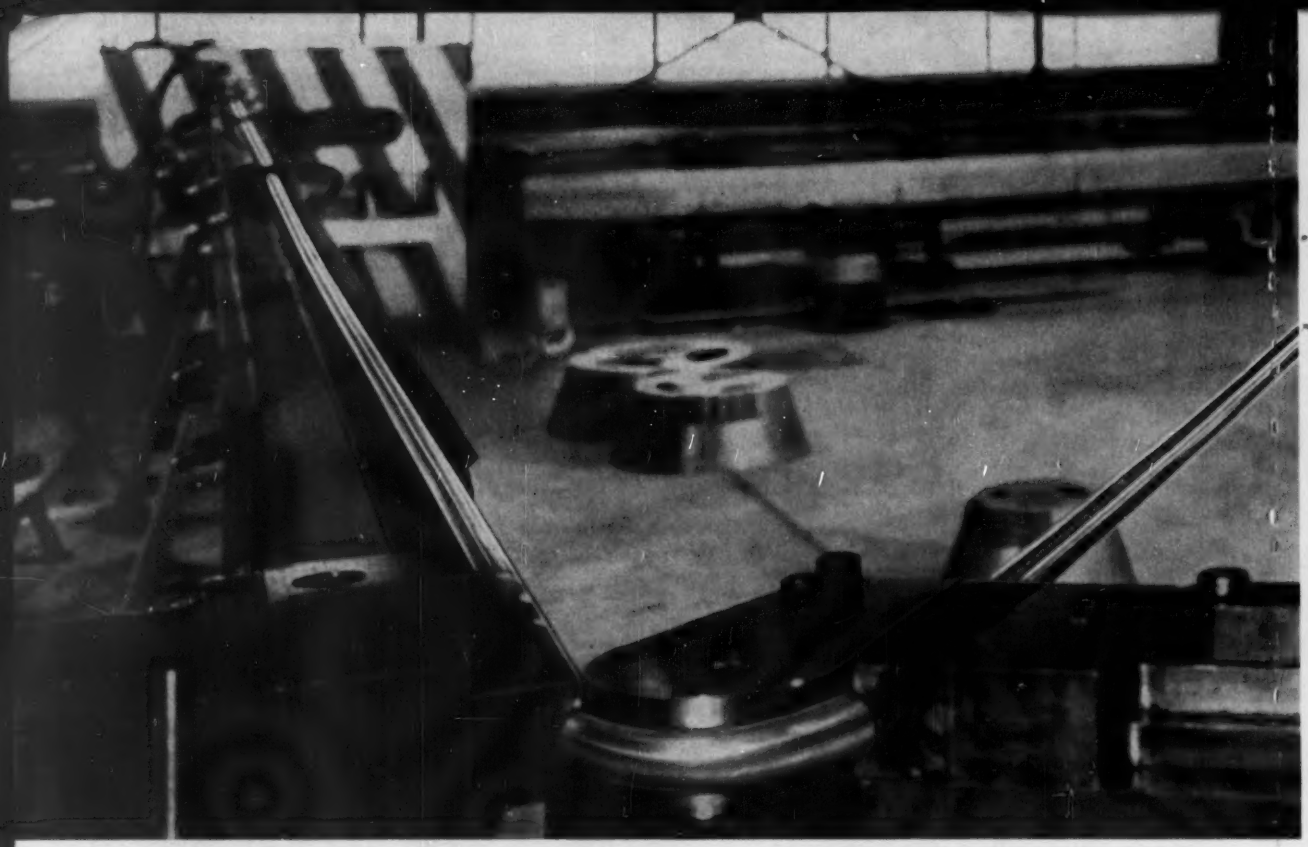


Versatile regulator valves offer new simplicity of design. Diaphragm-type CV-D (left) is designed for remote control service. It can be direct or reverse acting, has excellent rangeability. Piston-type CV-P (right) is designed for high-duty service . . . assures maximum power with precise positioning.

All Copes-Vulcan valves are tailored to the job. The style of valve part is selected to provide optimum control for specified operating conditions. Bulletin 1027.

For more facts circle 210 on Reader Service card, p 103

Circle 211 on Reader Service card for following ad ▶



Pre-bending to exact specifications can be done right in our Huntington Mill. Tubes up to 85 feet total length can be handled.

Once you see how Monel tubing is industry standards for use in

If you walked into the Huntington Mill you would notice large quantities of Monel* nickel-copper alloy tubing being made.

Monel alloy tubing is virtually the only tubing which can be used in heat exchangers of economical size designed to handle steam at the upper limits of pressure and temperature.

Now, you will notice in addition to Monel alloy tubing, a considerable quantity of Inconel* nickel-chromium alloy tubing in the works.

Tubing of both alloys is in wide demand for feedwater heaters, for pressurized-water reactors, for other heat exchange equipment subject to severe conditions.

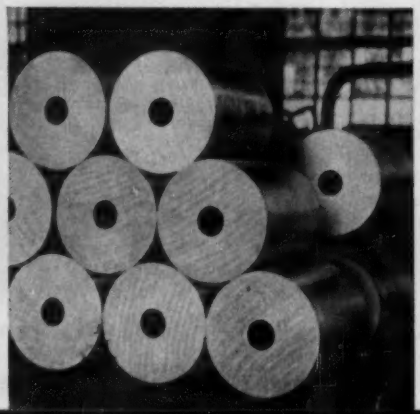
For such service, the physical and mechanical demands on the tubing, simply as tubing, are as great as the demands on the alloys themselves. Without such basics, for example, as a uniform, carefully annealed or stress relieved, metal structure, sound, tight, rolling or welding of tube ends into tube sheets could not be done with the needed reliability.

True IDs and ODs, good concentricity, uniform wall thicknesses, smooth inner and outer surfaces, freedom from internal and external defects are all of similar importance to heat exchanger fabricators and users.

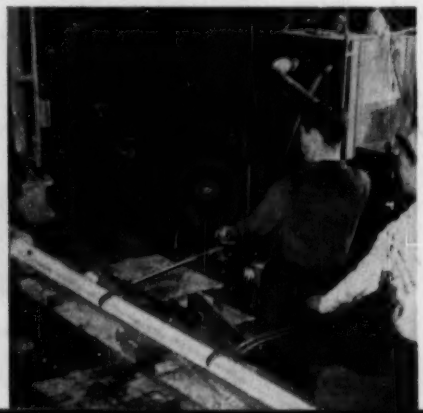
At Huntington, as these pictures demonstrate, precise manu-

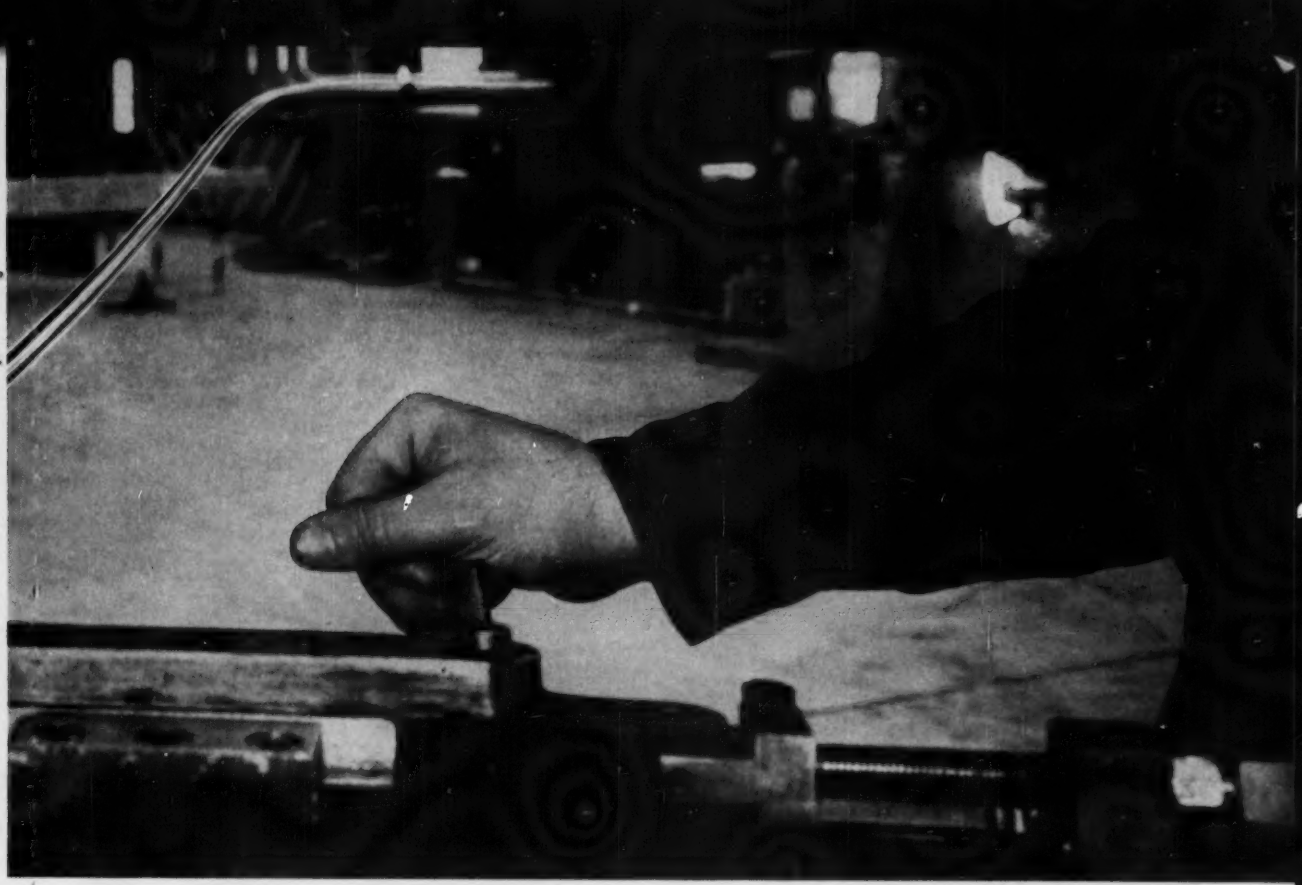
Control of alloy quality starts with the melt. Done in electric arc furnaces using high purity basic metals.

Extrusion billets are forged and machined to precise dimension. Here's where concentricity and uniform wall starts.



4000 tons of pressure extrude the Monel tubing through a precision die at temperatures around 2100°F.





produced you can see why it sets severely tried heat exchangers

facturing assures that Monel and Inconel alloy tubing is as outstanding as the alloys from which it is made. Sum it up this way; everything we've ever learned that can aid in providing you with superior tubing is done.

When desired, we go one step further and pre-bend Monel and Inconel tubing to exact specifications.

Finally every shipment is crated with the tubes "cushion" packed to prevent damage in transit and storage.

Tubes are produced in all standard IDs and walls, and in lengths overall up to 85 feet. When the need is urgent, they can be delivered in a hurry, too. For complete information and engineering data write:

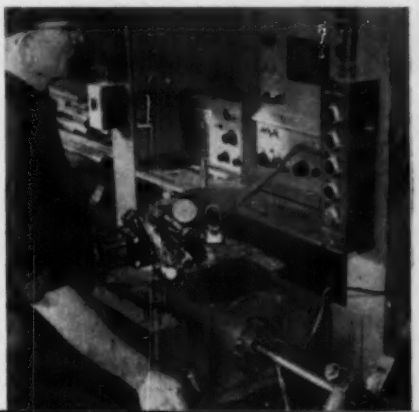
*Inco trademark

HUNTINGTON ALLOY PRODUCTS DIVISION
The International Nickel Company, Inc.
Huntington 17, West Virginia

INCO TRADE MARK **ALLOY PRODUCTS**

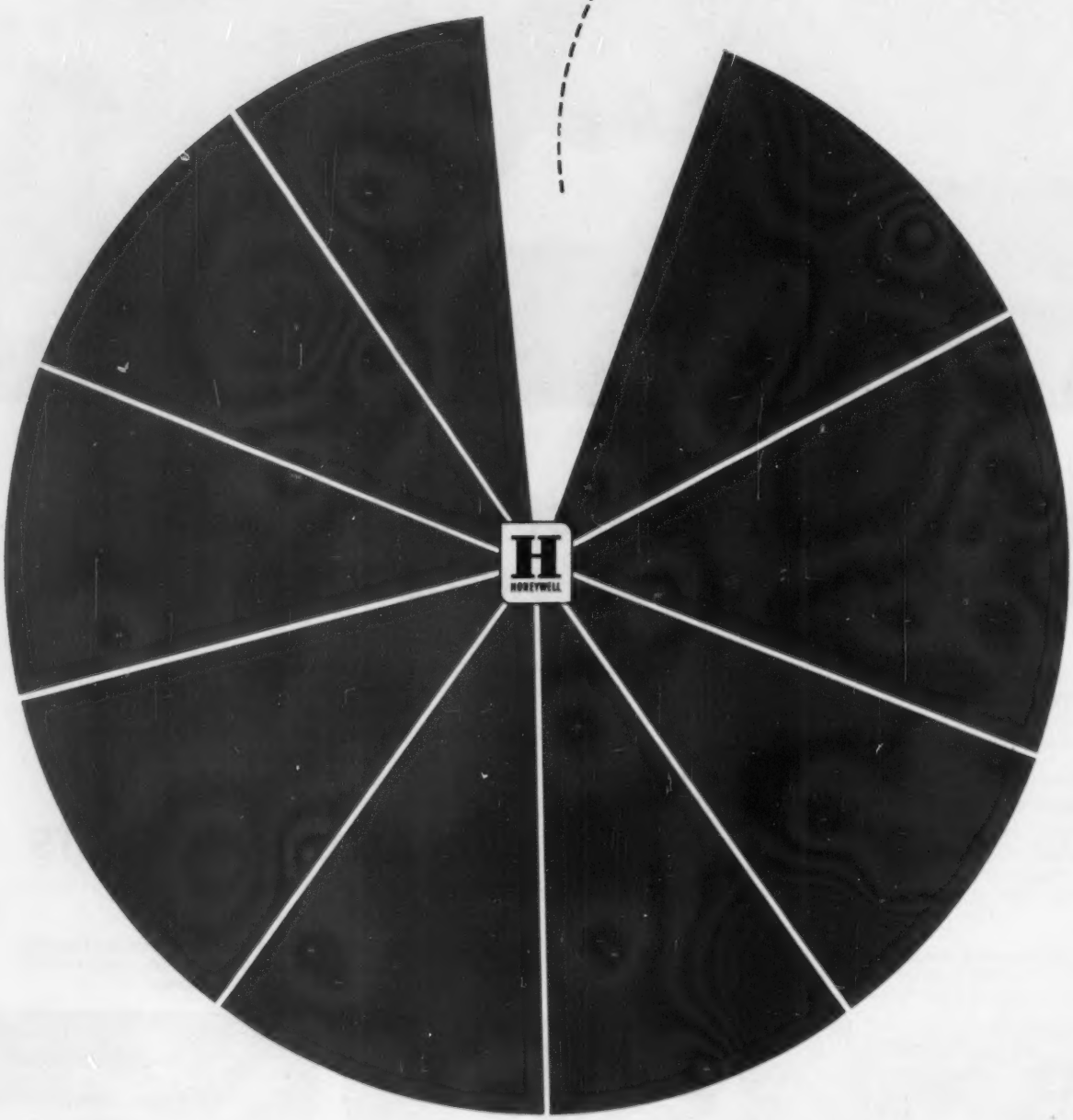
Three tubes at a time emerge from cold draw dies. Frequent diameter checks with a micrometer keep ODs accurate.

Silent sound probes every cubic centimeter of metal for defects. Inspection of 100% is assured with non-destructive testing.

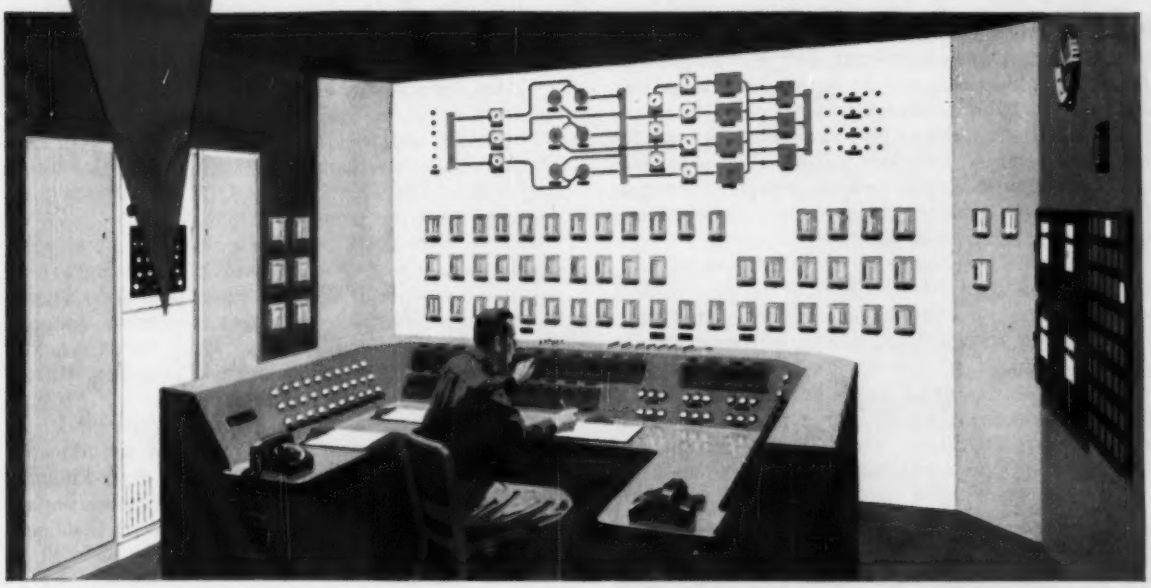


Cushion-packing and careful handling prevent damage to Huntington tubing on route or in storage.

A COMPUTER IS ONLY



PART OF A PROCESS CONTROL SYSTEM



You hear a lot about industrial process computers these days. As processes get bigger, faster and more complex, computers are being used as the reins as well as the brains—for control as well as data reduction—in fields as diverse as ice cream making and petroleum refining.

The Big Picture. But like the human brain, a computer cannot work independently. It must receive raw information from sensory instruments. Where automatic control is involved, it must transmit its logic to "muscle" instruments which translate decisions into action. The computer is part of a system, and, like the human body, the system functions effectively only when all of its parts are perfectly coordinated. In Honeywell systems, this compatibility of *all* system components is built in, for all Honeywell instruments and controls are *made* to complement each other.

Process Experience plus Computer Know-How. Equally important, a computer must be properly applied. Computers are "illiterate." They must be told what to do and how to do it by men who know. In engineering a computer-directed instrumentation system that will be precisely matched to your needs, Honeywell systems engineers draw on more than 75 years of measurement and control experience.

Single-Source Responsibility. Honeywell offers you a single contract covering your entire system. You get economy, convenience, simplified training of personnel, economical stocking of parts and accessories—*all* the advantages of single-source purchasing. And you get the only truly complete computer control package available from a single source.

MINNEAPOLIS-HONEYWELL, Wayne and Windrim Avenues, Philadelphia 44, Penna. In Canada, Honeywell Controls, Ltd., Toronto 17, Ontario.

75th YEAR
PIONEERING THE FUTURE

Honeywell

First in Control
SINCE 1885

For more facts circle 212 on Reader Service card, p 103

See why ALCOA ALUMINUM makes a good design habit

Requirement: Simple, low-cost heated lines to pipe high viscosity fluids
Key to Good Design: Specify UNITRACE and DUOTRACE, Alcoa's extruded aluminum pipes with integral steam chambers

With the development of UNITRACE® Piping, ALCOA created an entirely new technique for piping viscous fluids. Trace and product chamber are extruded in a single unit of light, strong, corrosion-resistant ALCOA® Aluminum. This integral steam-traced pipe eliminates the need for cumbersome, costly, inefficient pairing of separate pipes for steam and product. The resultant savings in initial cost are coupled with a major increase in the efficiency of heat application to the product piped.

Subsequent development of special flanges, elbows, adapter flanges and UNITRACE Trace Caps has made it possible to design and install completely integrated UNITRACE piping systems . . . compatible with standard piping components.

Now ALCOA has developed a new product, DUOTRACE,* to expand the design range of integrally traced piping systems. DUOTRACE contains not one but *two* trace chambers plus a product chamber in a single extruded aluminum pipe. This makes DUOTRACE the perfect solution to the need for recirculating tracing systems.

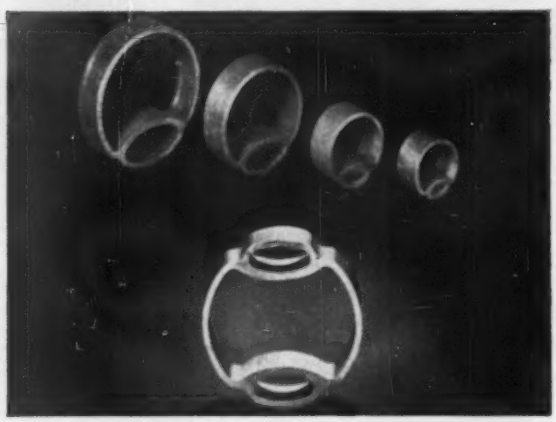
*Trademark of Aluminum Company of America

Today, the ingenuity of process industries designers has indicated intriguing new areas of potential use for both UNITRACE and DUOTRACE. Consider, for instance, the process economies which can result from the substitution of either UNITRACE or DUOTRACE for unit heat exchangers and preheaters.

Here you see an outstanding example of the way in which ALCOA is putting over 40 years of process industries experience to work to make aluminum your good design habit. You are invited to share that experience—through a series of engineering conferences which ALCOA is holding this year in a number of major cities. Your local ALCOA sales office will be happy to furnish details.

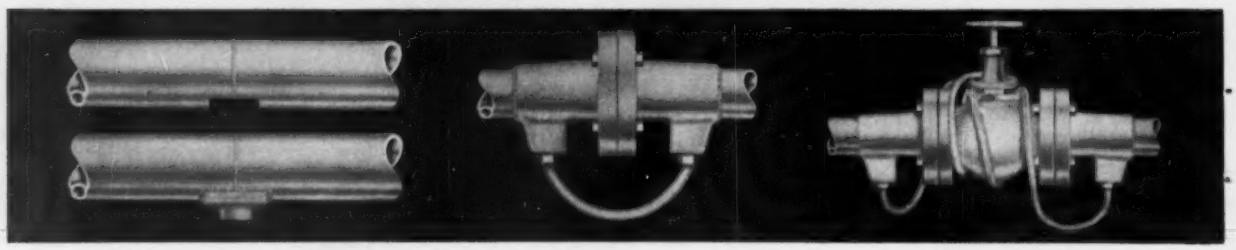
Take advantage, too, of the body of ALCOA literature which describes in technical detail the known performance characteristics of aluminum in a variety of process industries applications. Simply fill in and mail the coupon opposite. ALUMINUM COMPANY OF AMERICA, Alcoa Building, Pittsburgh 19, Pa.

World wide sales through ALCOA INTERNATIONAL, INC., 230 Park Avenue, New York 17, N.Y.

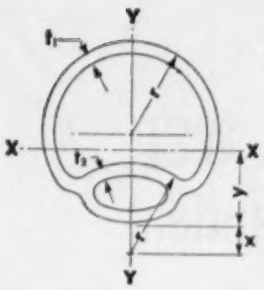


The development of DUOTRACE has opened broad new areas of design exploration in the field of heat transfer. By adding a second trace chamber to the one previously available in UNITRACE, DUOTRACE permits recirculation of the trace fluid. This opens up a whole new area of heat transfer design. Not the least of the possibilities is this: certain types of heat exchangers may now be extruded as single units. The cost savings implicit in such a unit are almost staggering. Alcoa engineers will be happy to assist you in exploring such design innovations in your own plant or process.

Fittings and connections for UNITRACE and DUOTRACE: Unflanged connections can be made easily and effectively with the special UNITRACE Trace Cap. As illustrated, trace chambers in adjoining sections are cut back and a circumferential weld is made to seal the product chamber. The cut back trace section is then covered with a UNITRACE Trace Cap welded in place with 4043 weld wire. Simple, efficient **flanged connections** utilize special UNITRACE flanges designed to accommodate both trace and product chambers. Jumper connections are used to carry the trace across the connection, and special impingement plates in the flange shield the product chamber from erosion as steam passes through the flange. **Valves, pumps and other fittings** can be incorporated into the traced systems by using UNITRACE flanges which mate with all 150-lb ASA flanges, valves and pumps. UNITRACE and DUOTRACE systems accommodate standard preformed pipe insulation.

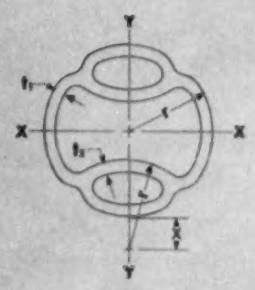


UNFLANGED CONNECTIONS FLANGED CONNECTIONS VALVES AND FITTINGS



	Unitrace Sizes	1 in.	1½ in.	2 in.	3 in.	4 in.	6 in.	8 in.
Axis XX	Moment of Inertia (I) in.⁴	.09	.34	.72	2.71	6.52	31.82	81.82
	Radius of Gyration (R) in.	.37	.58	.72	1.09	1.42	2.12	2.78
	Section Modulus (S) in.³	.13	.34	.56	1.42	2.65	8.73	17.22
Axis YY	Moment of Inertia (I) in.⁴	.09	.33	.70	2.65	6.36	29.72	76.70
	Radius of Gyration (R) in.	.37	.57	.71	1.08	1.40	2.05	2.69
	Section Modulus (S) in.³	.14	.34	.59	1.52	2.83	8.97	17.79

Sizes	1 in.	1½ in.	2 in.	3 in.	4 in.	6 in.	8 in.
r	.657	.950	1.187	1.750	2.250	3.312	4.312
t_1	.133	.145	.154	.170	.187	.280	.322
t_2	.145	.163	.174	.185	.200	.307	.354
x	.133	.344	.406	.625	.813	1.500	2.000
y	.61	.87	1.08	1.59	2.03	2.98	3.87



	Duotrace Sizes	1 in.	1½ in.	2 in.	3 in.	4 in.	6 in.	8 in.
Axis XX	Moment of Inertia (I) in.⁴	—	—	.80	3.06	7.53	—	—
	Radius of Gyration (R) in.	—	—	.74	1.12	1.46	—	—
	Section Modulus (S) in.³	—	—	.68	1.75	3.35	—	—
Axis YY	Moment of Inertia (I) in.⁴	—	—	.67	2.59	6.29	—	—
	Radius of Gyration (R) in.	—	—	.68	1.03	1.33	—	—
	Section Modulus (S) in.³	—	—	.57	1.48	2.80	—	—

Sizes	1 in.	1½ in.	2 in.	3 in.	4 in.	6 in.	8 in.
r	—	—	1.187	1.750	2.250	—	—
t_1	—	—	.154	.170	.187	—	—
t_2	—	—	.174	.185	.200	—	—
x	—	—	.531	.843	1.125	—	—
y	—	—	—	—	—	—	—

Unitrace-Duotrace Sizes	1 in.	1½ in.	2 in.		3 in.		4 in.		6 in.	8 in.
Product Area (in.²)	.64	1.68	2.72	2.36	6.38	5.67	10.84	9.74	24.64	42.79
Trace Area (in.² each)	.10	.16	.35	.22	.98	.61	1.86	1.07	2.85	5.12
Metal Area (in.²)	.65	1.03	1.39	1.46	2.28	2.46	3.24	3.53	7.05	10.60
Weight (lb/ft)	.77	1.22	1.66	1.72	2.71	2.89	3.85	4.16	8.38	12.60
*Min. Bend Radii (in.)	5	8	10½	10½	17	17	24	24	36	48
Wetted Perimeter (in.)										
Product	3.35	4.92	6.31	6.28	9.68	9.65	12.72	13.02	18.63	24.75
Trace (each)	1.49	1.71	2.40	1.87	4.13	3.22	5.32	4.23	6.75	9.63
Fitting Weights (lb)										
Trace-Caps	.102	.126	.240	.13	.464	.40	.674	.55	1.67	2.92
Elbows	.706	1.347	2.111	2.65	5.244	6.59	9.649	11.68	27.76	52.51
Impingement Plates	.024	.039	.057		.101		.162		.22	.34
Stub Ends				.65		1.50		2.13		
Terminal Casting				.50		1.12		1.75		

	1–2 in.	1½–2½ in.	2–3 in.	3–4 in.	4–6 in.	6–8 in.
Adapter Flanges	2.419	3.816	4.774	7.216	11.106	19.23

(Note: UNITRACE values are indicated in clear areas in the table above. DUOTRACE values are shown in the shaded areas.)
*Unitrace may be bent in any direction to these radii provided reasonable tooling is employed.

Aluminum Company of America, 868-L Alcoa Building, Pittsburgh 19, Pa.
Please send me the following literature covering Alcoa Aluminum for tubular products and other uses in the process industries:

☐ 10197 Aluminum Pipe and Fittings
☐ 10418 Alcoa Unitrace: Combines Piping and Tracing in One Unit
☐ 514 Alcoa Duotrace Technical Report
☐ 10270 Alcoa Utilitube
☐ 10460 Process Industries Applications of Alcoa Aluminum
☐ 11453 Solving Refinery Corrosion Problems with Aluminum
☐ 20849 Resistance of Aluminum Alloys to Weathering and Resistance of Aluminum Alloys to Chemically Contaminated Atmospheres
☐ 20437 Aluminum Alloy Heat Exchangers in the Process Industries
☐ 19416 Brazing Alcoa Aluminum
☐ 19415 Welding Alcoa Aluminum
☐ 19051 Alcoa Aluminum Handbook

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State _____

ALCOA ALUMINUM
ALUMINUM COMPANY OF AMERICA

For exciting drama watch "ALCOA THEATRE" alternate Mondays, NBC-TV, and "ALCOA PRESENTS" every Tuesday, ABC-TV

For more facts circle 213 on Reader Service card, p 103

new Yarway Unit Tandem Valve for blow-off service up to 665 lbs. WSP ...provides proven Yarway Unit Tandem dependability for medium pressure installations. Streamlined, light in weight, easy to operate, tight sealing, with minimum maintenance.

Ask for free Bulletin B-435, Supplement A

YARNALL-WARING COMPANY • 100 Mermaid Ave., Philadelphia 18, Pa.
BRANCH OFFICES IN PRINCIPAL CITIES

YARWAY
A MARK OF QUALITY IN STEAM ENGINEERING

TIGHT
Sealing valve is time-proven Yarway Seatless design.
TOUGH
Blowing valve features stellite-faced disc and integral stellite seat.
TRIM
Both valves, mounted together, permit more compact piping with reduced weight.

A FEW OF THE MANY SATISFIED USERS: U. S. Sugar Corp. • West Point Mfg. Co. • Hollingsworth Paper Co. • R. J. Reynolds Tobacco Co. • Pulp and Paper Co., Colombia, S. A. • Western Electric Co. • Cornell University

COMPACT
New "Welbloc" Gage Valves permit space-saving installation.
CLEAR
Brilliant water level readings through wide ports. Steam shows red; water shows green.
CONVENIENT
Individual "package" port assemblies easily quickly replaced.

improved Yarway Color-Port Gages for medium pressure boiler service to 1050 psi*—with new "Welbloc" Gage Valves—offer you reduced maintenance, increased operational time, brilliant red and green level readings.

*High pressure design for pressures to 3000 psi also available

Write for new Yarway Bulletin WG-1815

YARNALL-WARING COMPANY, 100 Mermaid Ave., Philadelphia 18, Pa.

BRANCH OFFICES IN PRINCIPAL CITIES

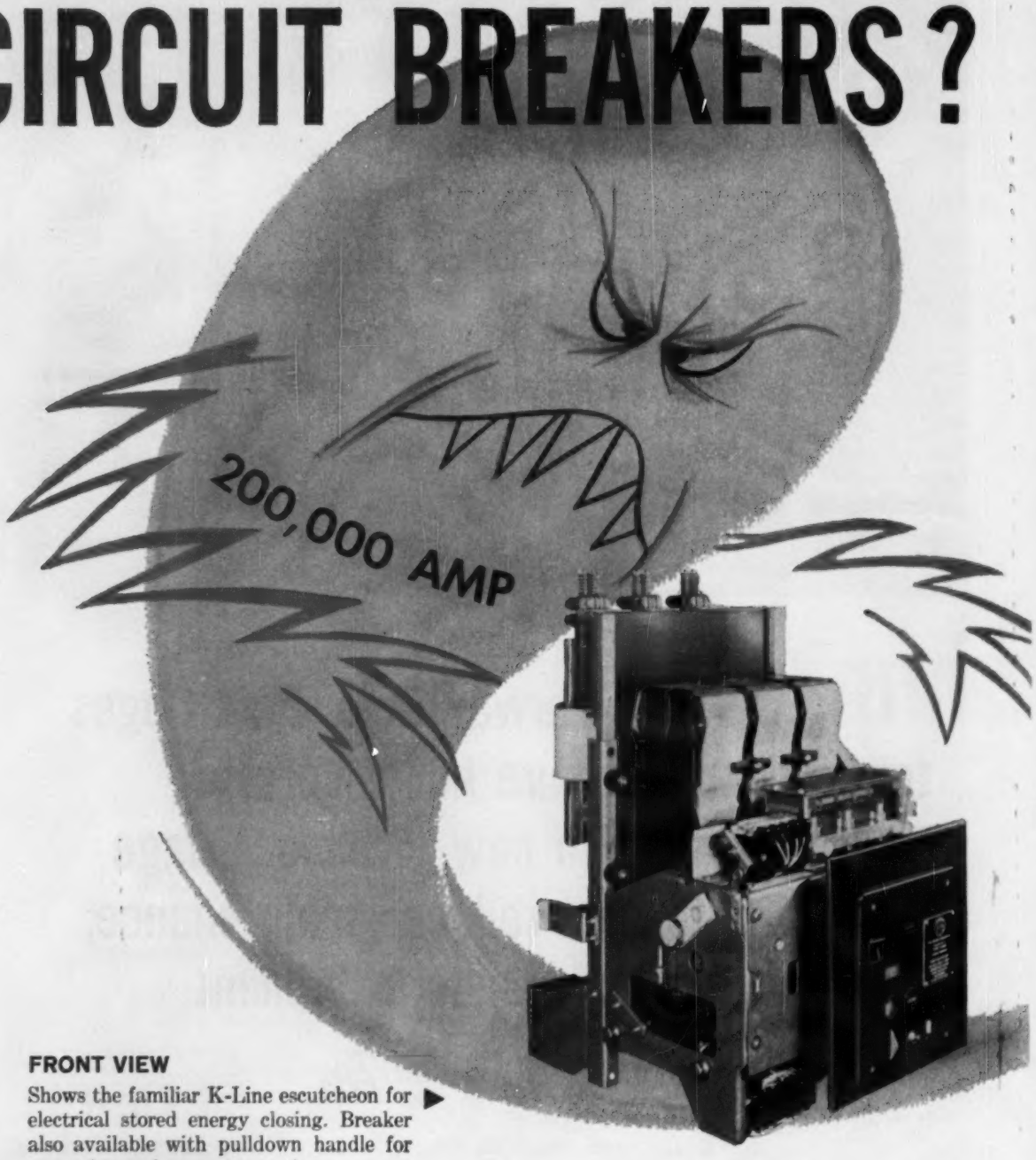
YARWAY
A MARK OF QUALITY IN STEAM ENGINEERING

A FEW OF THE MANY SATISFIED USERS OF COLOR-PORT GAGES

Mead Corporation
Shell Oil Company
Allis Chalmers Company
Alan Wood Steel Company
California Oil Company
City of Vineland, N. J.
General Chemical Co.
University of Texas
Pittsburgh Plate Glass Co.
Youngstown Sheet & Tube Company
E. I. du Pont de Nemours & Co.
Scott Paper Company

For more facts circle 214 on Reader Service card, p 103

HOW MANY AMPERES LURK BEHIND YOUR LOW VOLTAGE CIRCUIT BREAKERS?



FRONT VIEW

Shows the familiar K-Line escutcheon for electrical stored energy closing. Breaker also available with pulldown handle for manual stored energy operation.

I-T-E's new K-Don protects against fault currents up to 200,000 amp—plus giving you the complete range of K-Line circuit breaker operation

Suppose you have a low current fault. The K-Don circuit breaker element gives you time delay tripping. Or a medium current fault. You get instantaneous tripping. And for really high-capacity faults, you have the current-limiting action of Amp-trap® fuses in series with the breaker.

MAXIMUM FUSE ECONOMY

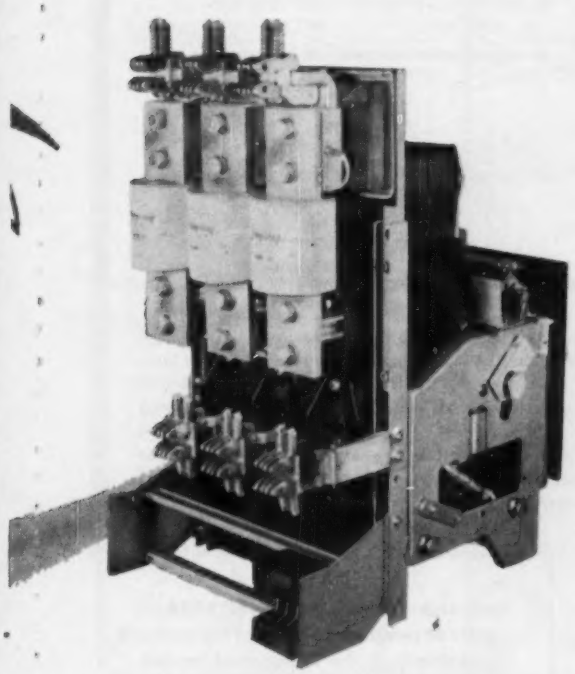
Only the I-T-E K-Don gives such complete protection—circuit breaker protection over the standard circuit breaker range and economical fuse protection from there on up to 200,000 amp. The only time fuses blow is when fault current is too high for the circuit breaker to handle. The K-Don is not a fuse hog.

NO SINGLE PHASING

The K-Don gives you this double protection all in a single compartment—saving you cost and bulk. And regardless of the type of fault, all three phases open every time. No single phasing to cause costly equipment damage.

COMPLETE RANGE OF RATINGS

Basically, the K-Don is a standard 600 volt K-Line circuit breaker with current-limiting fuses in series. Besides high current protection, you also get the advantages of expanded range trip and closed door drawout. Breaker ratings range from 30 to 1600 amp continuous, up to 75,000 amp interrupting. Versatility of protection is assured by a range of fuse ratings from 400 to 3000 amp. Drawout mountings are available in either Urelite® enclosures or switchgear assemblies. Write for detailed bulletin 4300-1A. I-T-E Circuit Breaker Company, 1900 Hamilton St., Philadelphia 30, Pa.



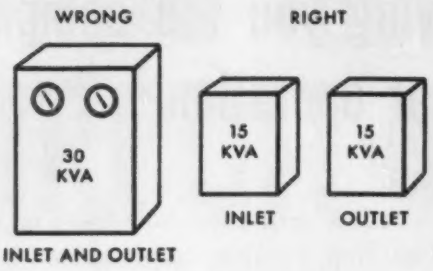
BACK VIEW

◀ Shows Amp-trap current-limiting fuses in series with circuit breaker. Fuses are on line side so they protect the breaker as well as connected equipment.

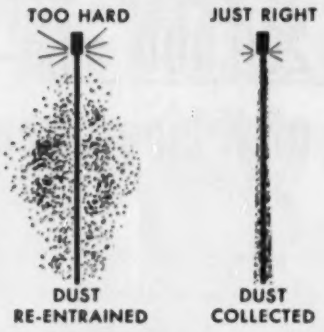
I-T-E CIRCUIT BREAKER COMPANY

For more facts circle 215 on Reader Service card, p 103

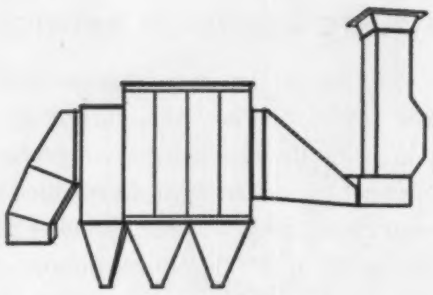
How to Evaluate Cottrell Precipitators



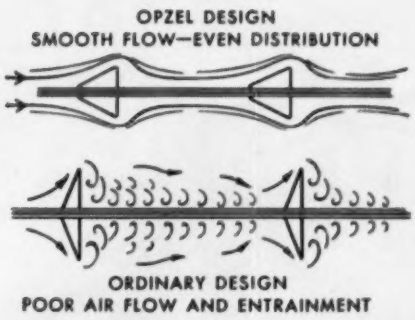
1. Electrical Sets should be arranged and rated to suit best the requirements of a specific job. Since electrical conditions can vary widely at different parts of the precipitator, it is good design to include several electrical sections in series, energized from separate sets so that each section may be energized as needed. Sets should be sized according to the amount of power the precipitator can absorb. A large excess of installed power, which will never be absorbed, means inefficient use of its equipment.



3. Rapping Intensity. Rappers should have easy means to vary the intensity of the blow to suit variations in operating conditions. A pre-set intensity setting cannot possibly give proper rapping over the normal range of operation. If too soft, build-up will occur which will disturb electrical conditions. If too hard, there will be reentrainment. Means of intensity adjustment are necessary to avoid drop-off of precipitator efficiency as conditions change.


3 DIMENSION MODEL

2. Gas Distribution. Remember that gas distribution, gas baffling, and provision against hopper sweeping all have a large influence on collection efficiency. The gas flow system should be analyzed as closely as possible, both in the precipitator and in the associated duct-work. If in doubt, have a three-dimensional gas flow study made. Two-dimensional gas flow studies *are not as accurate* and may lead to erroneous conclusions.



4. Baffle Design. Careful attention to the design of baffles on the collecting plates is most important. Small amounts of reentrainment mean tremendous differences in over-all collection efficiencies. It is seen that the "quality" of the collecting surface is far more important than quantity—quantity (sq. ft. of surface or treatment time) in itself is not a criterion of performance.

The point of all this is that so many factors enter into evaluating an electrical precipitator that you should consult with the leading manufacturer—Research-Cottrell

Research-Cottrell, with over 1198 years of combined engineering skill and experience, is the undisputed leader in electrical precipitation.

Research-Cottrell

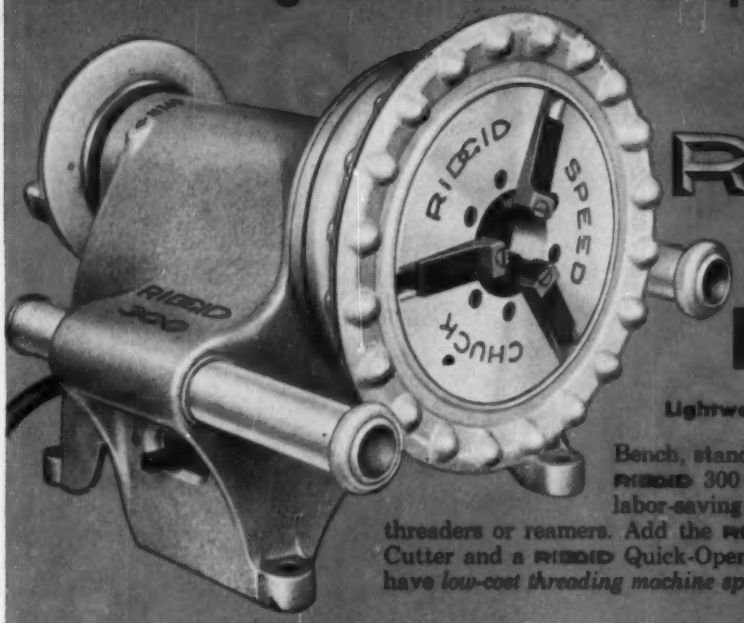
RESEARCH-COTTRELL, INC., Main Office and Plant: Bound Brook, N. J.
Representatives in principal cities of U.S. and Canada

RC 804

COTTRELL TRADE MARK

For more facts circle 216 on Reader Service card, p 103

Time-Saving Power For Your Shop or on the Job...



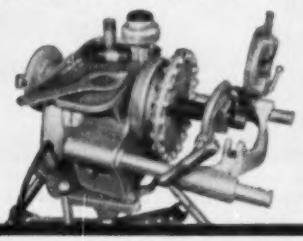
New RIDGID 300 Power Drive

Lightweight • Versatile • Low in Price

Bench, stand or truck mounted, this compact RIDGID 300 Power Drive gives you time and labor-saving power for your hand cutters, threaders or reamers. Add the RIDGID No. 310 Carriage, No. 360 Cutter and a RIDGID Quick-Opening Machine Die Head, and you have *low-cost threading machine speed and ease!*

Here's What it Does!

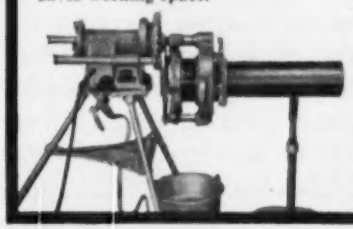
CUTS RIDGID No. 360 Cutter, shown here, cuts ⅛" to 2" pipe and conduit — up to ⅜" rod. Extra-wide rolls keep cutter straight for perfect high-speed tracking. Cutter stays back out-of-way when not in use.



THREADS RIDGID No. 535 Quick-Opening Die Head locks in position on easy-sliding Carriage to thread ⅛" to 2" pipe... ¼" to 2" rod. No slow back-off ... dies release at flip of lever. Any RIDGID Machine Pipe and Bolt Die Head may be used.

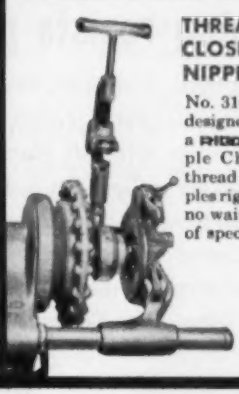
REAMS 300 Power Drive does all the work. Heat treated cutting edges of RIDGID "LonGrip" Reamer won't dig in ... produce smooth pipe or conduit walls in seconds.

DRIVES GEARED THREADERS Compact, RIDGID No. 300 Power Drive has plenty of power for up to 12" geared tools. New RIDGID Close-Coupled drive shown here, for Nos. 141 and 161 Jam-Proof Threaders eliminates Universal Drive Shaft ... saves working space.



THREADS CLOSE NIPPLES

No. 310 Carriage is so designed that by using a RIDGID No. 19 Nipple Chuck you can thread even close nipples right on the job... no waiting for nipples of special lengths.



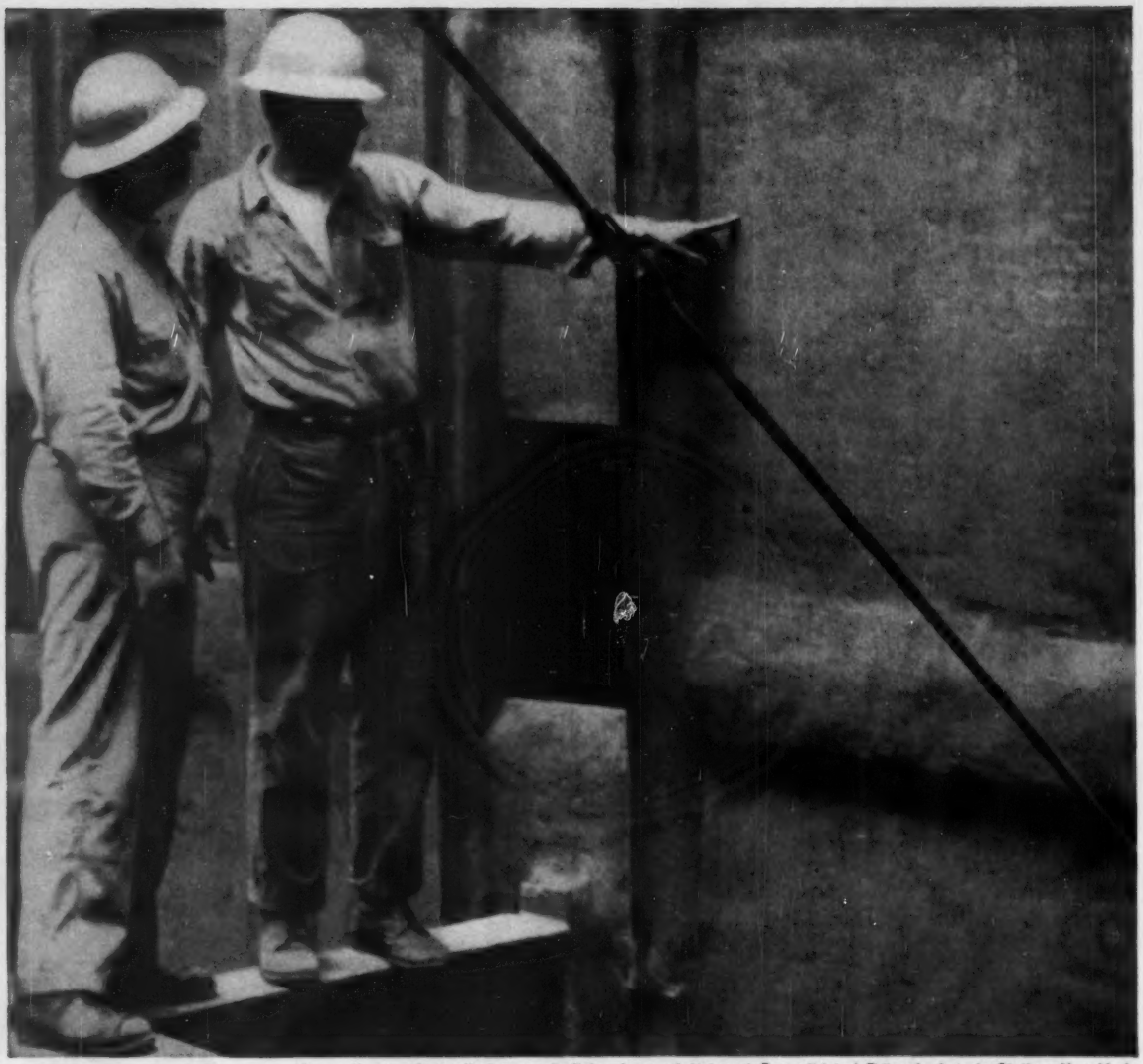
AND IS EASY TO MOVE With the aid of the Transporter, one man can easily move a RIDGID 300 Power Drive with its No. 1206 Folding Stand attached. Set-up is fast and easy. Stand's integral tool tray locks legs in position, forming rigid work base.

Save Time and Increase Your Profits on Every Job. See and Try This Biggest "Threading Machine" Bargain at your Supply House!

RIDGID

The Ridge Tool Company, Elyria, Ohio, U.S.A.

For more facts circle 217 on Reader Service card, p 103



Inspecting newly gunited concrete lining in precipitator at Consolidated Edison's Astoria Station, New York. **Contractor:** Research-Cottrell, Inc., Bound Brook, N. J. **Gunite Contractor:** J. A. McCollum, Inc., Marlton, N. J

Industrial concrete lining resists precipitator corrosion

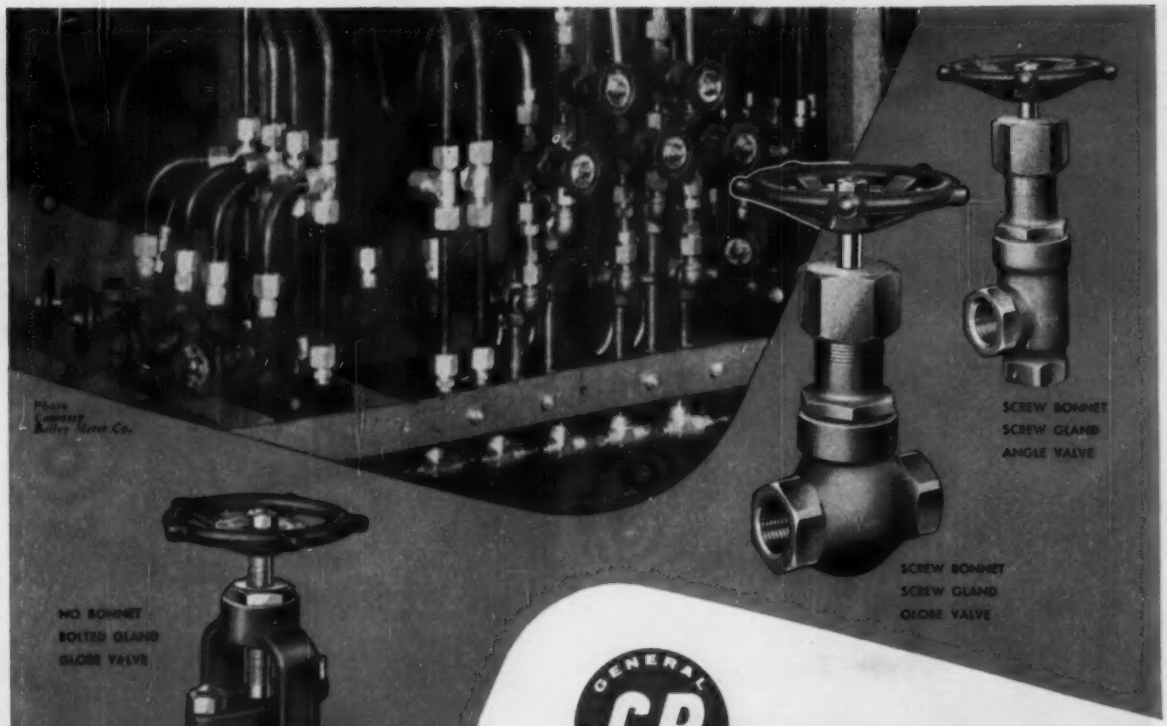
Concrete linings of LUMNITE calcium-aluminate cement and aggregate are specified for power plant precipitators to protect against the corrosive effects of acid condensate and the abrasion of fly ash. Placement is fast, easy, economical — by guniting, pouring or plastering. Since the concrete reaches service strength within 24 hours, downtime is reduced. For greater convenience there are castables made with LUMNITE cement. These packaged mixtures, available from leading manufacturers of refractories, are ready to place when mixed with water. For more information, write Universal Atlas Cement, 100 Park Avenue, New York 17, N. Y.

"USS," "Atlas" and "Lumnite" are registered trademarks L-207

Universal Atlas Cement
Division of
United States Steel

Offices: Albany · Birmingham · Boston · Chicago · Dayton · Kansas City · Milwaukee · Minneapolis · New York · Philadelphia · Pittsburgh · St. Louis · Waco

For more facts circle 218 on Reader Service card, p 103



GENERAL GP PURPOSE

FORGED STEEL *INTEGRAL SEAT* METER AND GAUGE LINE VALVES

Union Bonnet, Screw Bonnet and No Bonnet Types

Service proved Vogt GP Forged steel valves are the choice of leading meter and gauge Manufacturers for top performance and unfailing reliability.

They are available in sizes from ¼" to 2" of carbon steel for general purpose duty and of all-stainless where highly corrosive liquids are involved. All stems are one-piece 13% Chrome Stainless Steel with fine pitch threads for accurate regulation of flow. Special packing is furnished when specified.

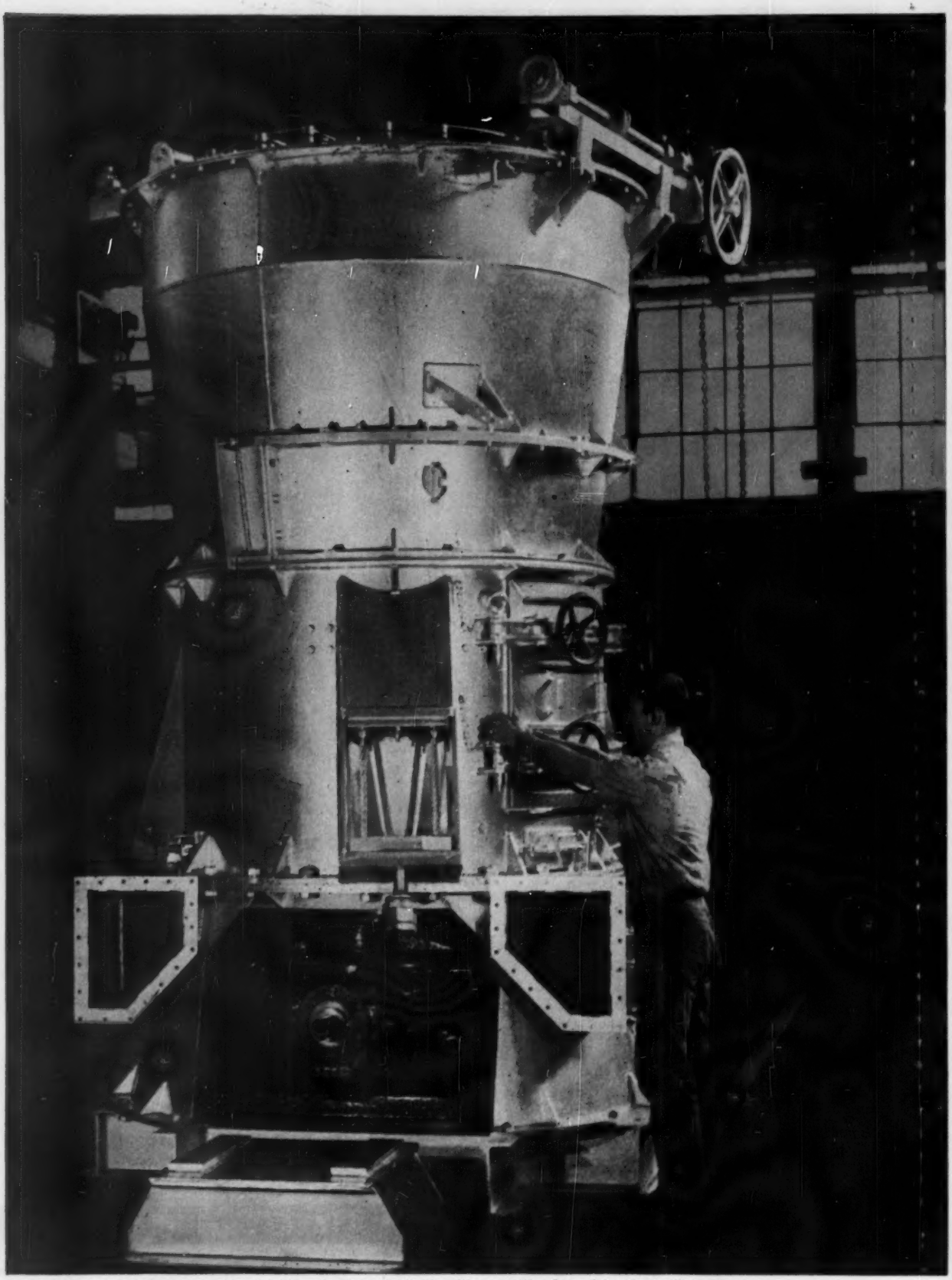
Catalog F-10 contains the complete Vogt line of valves, fittings, flanges and unions. Available upon request on your letterhead. Address Dept. 24A-FP.

HENRY VOGT MACHINE CO., P. O. Box 1918, Louisville 1, Ky.

SALES OFFICES: New York, Chicago, Cleveland, Dallas, Camden, N. J., St. Louis, Charleston, W. Va., Los Angeles.

Vogt FORGED STEEL VALVES, FITTINGS, FLANGES and UNIONS

For more facts circle 219 on Reader Service card, p 103



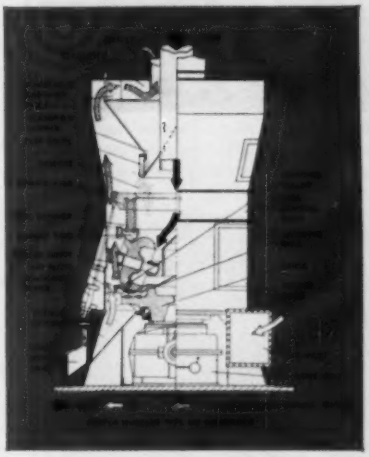
Foster Wheeler MB planetary roll and table pulverizer. Available with capacities from 2 ton/hr to 55 ton/hr.

Foster Wheeler MB Pulverizer, SIMPLE...VERSATILE...RELIABLE

The best combination of advantages for a wide range of fuel requirements

COMPARISON: Foster Wheeler MB pulverizer compared with two other leading pulverizers (A & B) available in U.S.

Power consumption	equal to A & B
Availability	better than A, equal to B
Accessibility	better than A & B
Floor Space	equal to A & B
Flexibility for suction or pressure operation	equal to A, better than B



European power companies have used the MB pulverizer for over 10 years. Low power consumption, low maintenance and the extremely high availability of the design are thoroughly proven.

Now further refined by FW engineers, and tested for two years in the U.S., the MB pulverizer deserves careful consideration in planning any fuel system which may require mill capacities from 2 to 55 tons of pulverized fuel per hour.

The MB design is extremely simple, providing reliability and ease of maintenance. The only moving parts inside the grinding area are three spheroidal rollers, a roller guide, and the powered horizontal grinding table. All adjustments can be made with the mill in operation.

The planetary motion of the rollers maintains uniform product fineness. Wear of grinding surfaces is extremely slow. The rollers and carrier need no lubrication. Noise and vibration levels are very low.

Provision is made for either pressurized or suction operation. In addition to coal pulverizing, the MB mill is also available for grinding gypsum, cement, solid chemicals, pigments, food products and other commercial materials.

Write for Bulletin MB-58-1, giving more detailed specifications for the MB mill. Foster Wheeler Corporation, 666 Fifth Avenue, New York 19, N. Y.

FOSTER WHEELER

NEW YORK LONDON PARIS ST. CATHARINES, ONT.

Refinery licks tough heat exchanger crisis with emergency tube service

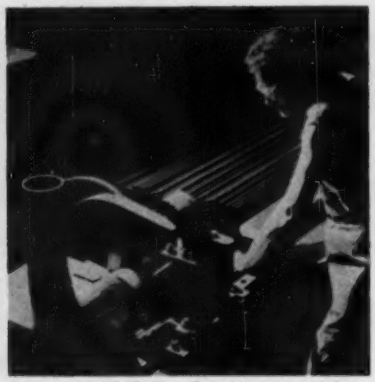
A sudden tube failure at the Pure Oil Company's Refinery in Lemont, Illinois, recently put Bridgeport's condenser tube service to the test. The failure hit on Friday afternoon—just before business slowed down for the week end. Faced with the prospect of costly equipment down time, the refinery called Bridgeport's Chicago office to find out how fast new tubes could be supplied. Here's a round-the-clock story of how the emergency was licked.

Friday, 2:30 P. M.: Salesman from Bridgeport's Chicago office learns that Pure Oil needs 900 Admiralty condenser tubes, and fast.

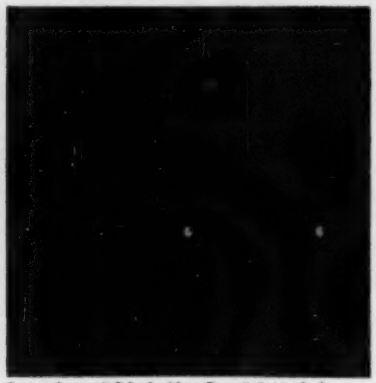
Friday, 3:00 P.M.: Salesman contacts our Bridgeport, Connecticut, mill and is informed that order can be delivered to Pure Oil Refinery in one week.

Friday, 3:30 P.M.: Sudden change in customer's needs makes immediate delivery of tubes imperative.

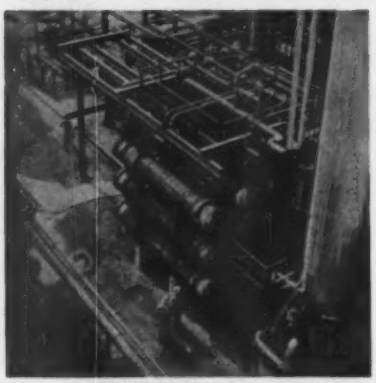
Friday, 4:15 P.M.: Chicago office checks through coast to coast network of Bridgeport warehouse stocks. Locates tubes at Beaumont, Texas.



Friday, 4:30 P.M.: Special night shift at Beaumont is put on job to cut tubes to special lengths and pack for shipment.



Saturday, 4:00 A.M.: Special truck leaves Beaumont, Texas, with order for Pure Oil Refinery in Lemont, Illinois.



Sunday, 11:30 P.M.: Truck arrives at Lemont Refinery with 900 Admiralty tubes, ready for repair work to start Monday morning.

While emergencies like this don't happen every day, they do prove dramatically that Bridgeport's customer service can come to the rescue. When we talk about fast service from our network of sales offices and warehouses, we mean it. Let us tell you more about our service on your condenser and heat exchanger tube needs, whether they're emergencies or normal deliveries. Call your nearest Bridgeport Sales Office, or get in touch with us direct.

Write for your free copy of Bridgeport's Condenser and Heat Exchanger Tube Handbook. Address Dept. 5411.

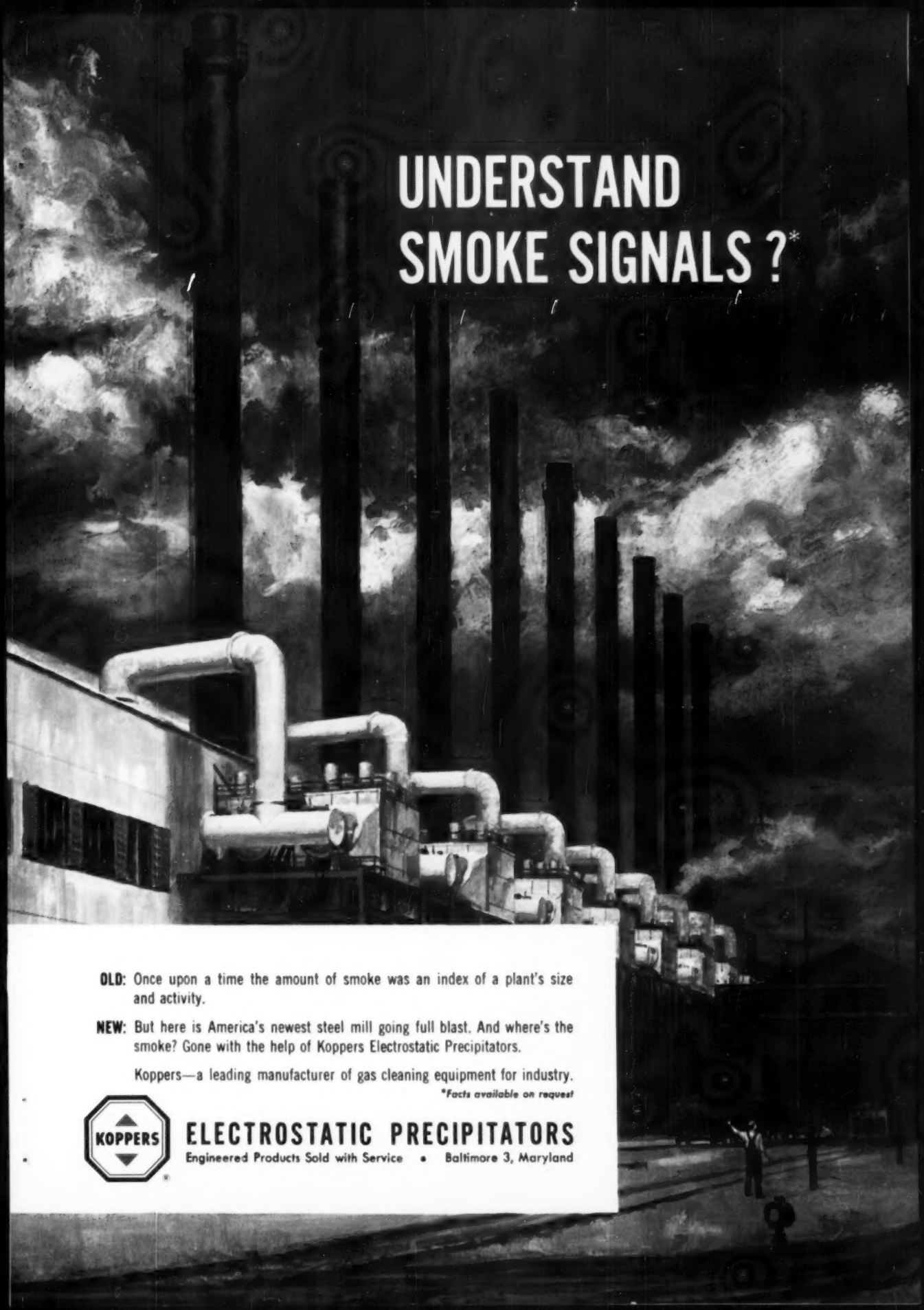
BRIDGEPORT BRASS COMPANY

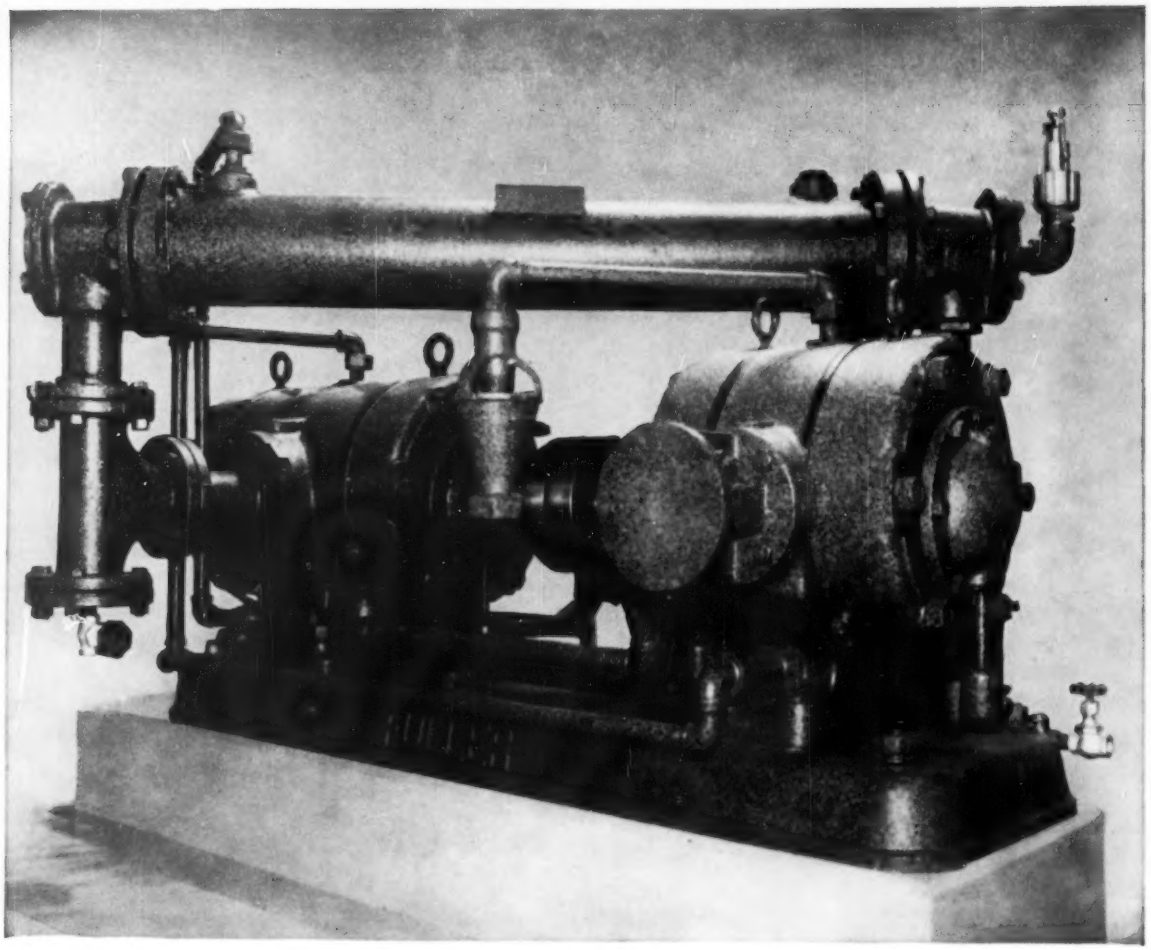
Bridgeport 2, Connecticut • Sales Offices in Principal Cities

Specialists in Metals from **A***luminum to* **Z***irconium*

For more facts circle 221 on Reader Service card, p 103

circle 222 on Reader Service card, p 103 ➤


UNDERSTAND
SMOKE SIGNALS?*
OLD: Once upon a time the amount of smoke was an index of a plant's size and activity.
NEW: But here is America's newest steel mill going full blast. And where's the smoke? Gone with the help of Koppers Electrostatic Precipitators.
Koppers—a leading manufacturer of gas cleaning equipment for industry.
*Facts available on request
KOPPERS
ELECTROSTATIC PRECIPITATORS
Engineered Products Sold with Service • Baltimore 3, Maryland



Fuller Compressors With Overhead Intercoolers Offer A New Dimension In Compactness

Fuller Rotary Two-Stage Compressors equipped with Overhead Intercoolers fill the bill where space may be a problem. These compressors produce from 30 to 3300 cfm, pressures to 125 lb. gage and can be readily installed.

These compact Rotary Compressors are vibration-free, thereby eliminating the need for involved and expensive foundations or structural modifications.

The Fuller rotary principle permits complete freedom of reciprocating parts—valves, crankshafts, pistons—cutting the need for frequent servicing and parts replacement. Minor maintenance is all the care indicated for years of serviceability.

For full details on the maintenance-free economy and high performance of Fuller rotaries, write today for comprehensive, illustrated Bulletin C-5A. 2626 C359

FULLER COMPANY GENERAL AMERICAN TRADE MARK

FULLER COMPANY
126 Bridge St., Catasauqua, Pa.
Subsidiary of General American Transportation Corporation
Offices in Principal Cities Throughout the World

Fuller
...pioneers in harnessing AIR

For more facts circle 223 on Reader Service card, p 103

this catalog... will show you why

Specifically designed for HOT WATER operation ... with all these features:

- Venturi-Action Mixing-Tube
- 4-Pass Down-Draft Design
- Built-in Induced Draft
- Fires Gas Oil or Both
- Fully Automatic
- Hinged or Davited Doors
- Insulated and Jacketed
- Factory-fire-tested
- Complete package with undivided responsibility

For sizes to 11,720,000 Btu's/hr., write for catalog CCW-11

For sizes to 20,100,000 Btu's/hr., write for catalog CFW-11.

SUPERIOR "TYPE CC"

Completely Packaged

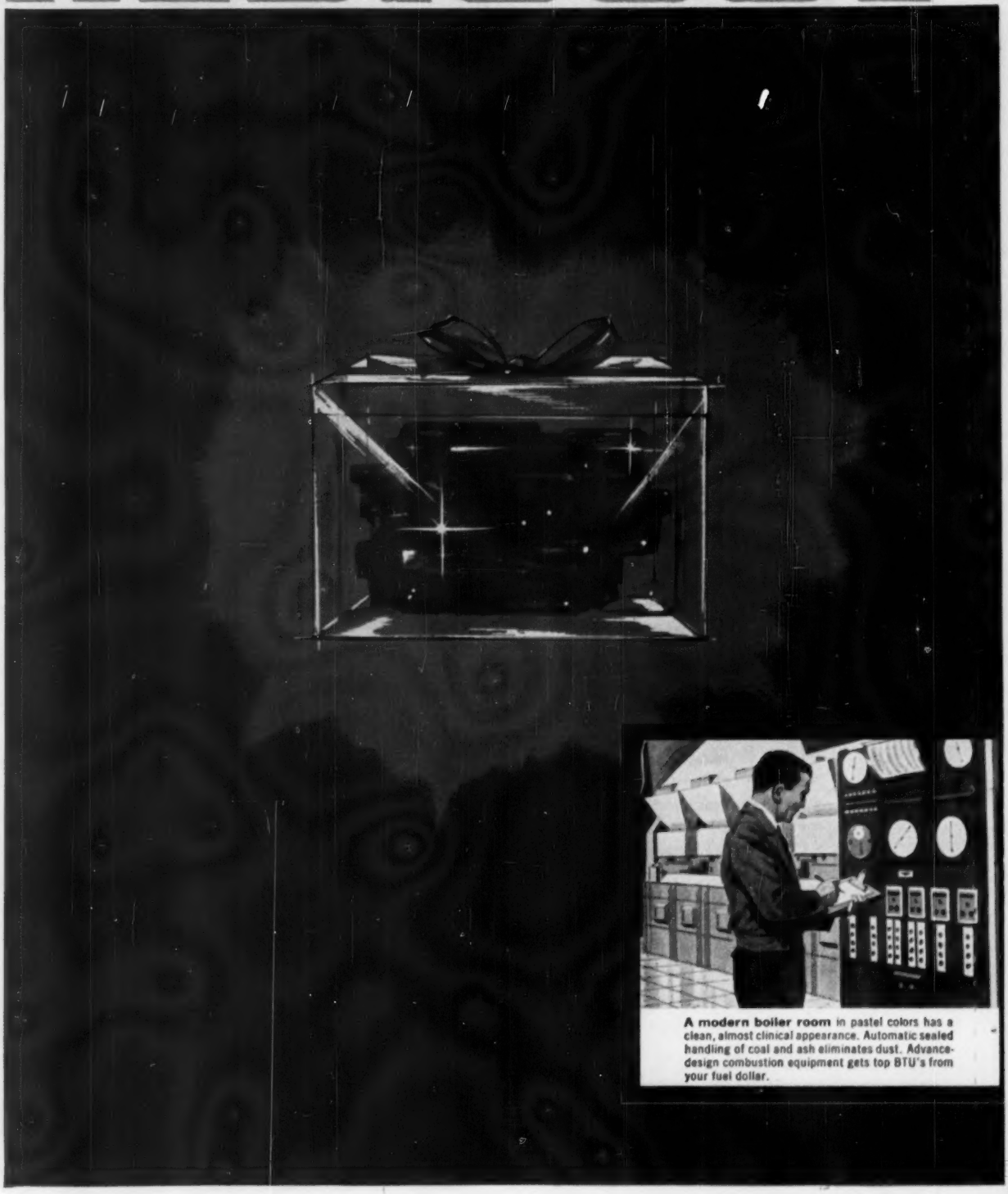
HOT WATER BOILERS are best... for hot water heating

Specialists in PACKAGED BOILERS... exclusively

SUPERIOR COMBUSTION INDUSTRIES, INC.
TIMES TOWER, TIMES SQUARE, NEW YORK 36, N.Y.

SUPERIOR PACKAGED BOILERS

REDISCOV



A modern boiler room in pastel colors has a clean, almost clinical appearance. Automatic sealed handling of coal and ash eliminates dust. Advance-design combustion equipment gets top BTU's from your fuel dollar.

ER COAL !

COAL IS CLEAN because of advanced techniques in processing and combustion

The clean handling, clean burning characteristics of coal brought about by technological advances in preparation and combustion equipment, have made it an even stronger logical choice for low-cost, efficient fuel.

To provide a cleaner, more uniform product, the progressive coal mining industry has developed and installed radically new techniques in mining and preparation. More are on the way, too, as new mines become truly push-button mechanized.

Phenomenal, too, are the strides made in handling and combustion equipment. Sealed conveyor systems, dustless operation, fly ash reinjection, hydraulic ash carriers, electrostatic precipitators, and other innovations give coal a *clean* bill of health.

Through low-cost and high efficiency, coal provides more energy for your fuel dollar. Chesapeake and Ohio transports it economically from the world's finest bituminous coal reserves. Coal is the one fuel that will be available for centuries.

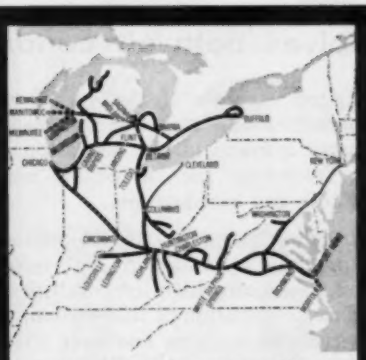
Chesapeake and Ohio Railway

TERMINAL TOWER, CLEVELAND 1, OHIO

Outstandability in Transportation

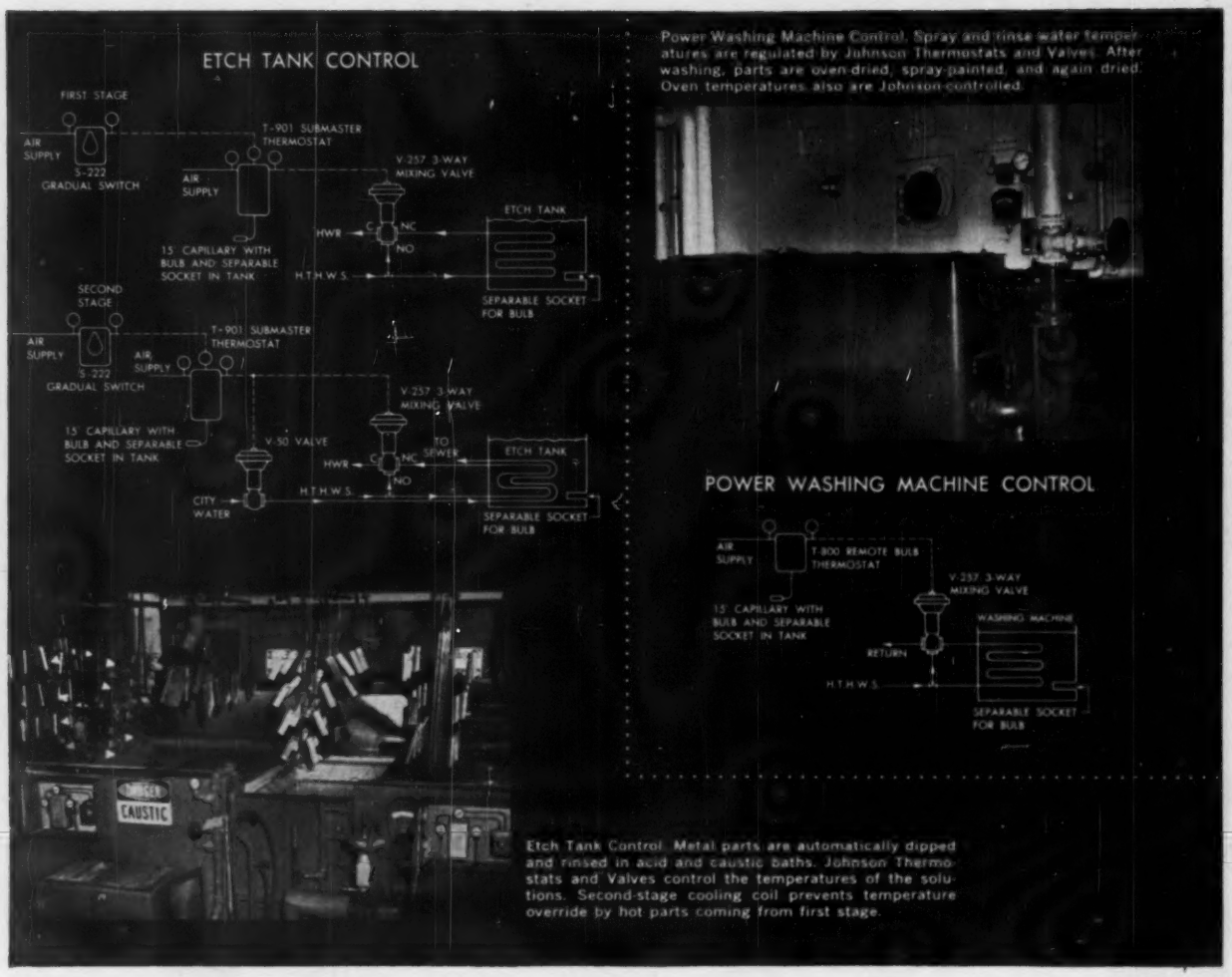
Coal is a good neighbor because of developments in modern equipment that offer stoker-to-stack cleanliness. Textile plants, laundries, hospitals now avail themselves of this reliable, efficient and convenient fuel.

C&O Fuel Service Engineers provide free consultation to C&O patrons on combustion, application, equipment, or plant arrangement problems. Write to R. C. Riedinger, General Coal Traffic Manager, above address.



The 5,100-mile Chessie Route directly serves over 300 mines in America's richest bituminous coal reservoir with the finest fleet of 68,000 coal cars. Specify C&O routing for dependable, efficient delivery.

CHESSIE SERVES THE COAL BIN OF THE WORLD


ETCH TANK CONTROL
FIRST STAGE
AIR SUPPLY
S-222 GRADUAL SWITCH
T-901 SUBMASTER THERMOSTAT
AIR SUPPLY
V-257 3-WAY MIXING VALVE
ETCH TANK
HWR
C
NC
NO
15' CAPILLARY WITH BULB AND SEPARABLE SOCKET IN TANK
H.T.H.W.S.
SEPARABLE SOCKET FOR BULB
SECOND STAGE
AIR SUPPLY
S-222 GRADUAL SWITCH
T-901 SUBMASTER THERMOSTAT
AIR SUPPLY
V-257 3-WAY MIXING VALVE
15' CAPILLARY WITH BULB AND SEPARABLE SOCKET IN TANK
V-50 VALVE
TO SEWER
ETCH TANK
HWR
NC
NO
CITY WATER
H.T.H.W.S.
SEPARABLE SOCKET FOR BULB
CAUSTIC
Power Washing Machine Control. Spray and rinse water temperatures are regulated by Johnson Thermostats and Valves. After washing, parts are oven-dried, spray-painted, and again dried. Oven temperatures also are Johnson-controlled.
POWER WASHING MACHINE CONTROL
AIR SUPPLY
T-800 REMOTE BULB THERMOSTAT
V-257 3-WAY MIXING VALVE
15' CAPILLARY WITH BULB AND SEPARABLE SOCKET IN TANK
WASHING MACHINE
RETURN
H.T.H.W.S.
SEPARABLE SOCKET FOR BULB
Etch Tank Control. Metal parts are automatically dipped and rinsed in acid and caustic baths. Johnson Thermostats and Valves control the temperatures of the solutions. Second-stage cooling coil prevents temperature override by hot parts coming from first stage.

JOHNSON CONTROL has dual role at

Solves both air conditioning and process control problems

A good example of the varied ways in which Johnson Pneumatic Control Systems serve industry is found in the Beaverton, Oregon, plant of Tektronix, Inc., a leading manufacturer of cathode-ray oscilloscopes.

Air conditioning for the 1.3 million sq. ft. plant is provided by a modern high-velocity dual-duct system utilizing high temperature water at 400 F. Efficient operation of this system, which includes central fan systems and over 555 high-pressure mixing units, is assured by a specially planned Johnson Pneumatic Control System. Strategically located Johnson Thermostats maintain the exact thermal conditions required for each production area and office. Thermostats and compressed air piping are arranged for complete flexibility in meeting new demands due to changes in plant layout and usage.

Reliable, trouble-free process regulation is also provided by Johnson equipment. This includes the control of etch tanks, steam degreasers, power washing machines, and ovens. Instantaneous domestic hot water heaters using high-temperature water, are also Johnson-controlled.

Johnson Pneumatic Control is applied to all types and makes of air conditioning, heating, and ventilating equipment, and to a wide range of industrial processes. Each system is engineered and installed to meet the specific requirements of the individual plant. Next time you are considering controls, investigate the advantages Johnson Control can give you — in performance, dependability, and operational savings. Call your architect, consulting engineer, or local Johnson representative. Johnson Service Company, Milwaukee 1, Wisconsin. 105 Direct Branch Offices.

Assembly Area Control. Space temperatures are regulated by fast-acting Johnson Thermostats, each of which controls one or more high-pressure mixing units, depending on the size and use of the area. Johnson Air Flow Controllers assure positive constant-volume air discharge by each unit.

Tektronix

Johnson makes the most complete line of pneumatic controls in the industry for solving any problem of temperature, humidity, and pressure control. Equipment includes thermostats, valves, dampers, damper operators, pressure regulators, humidostats, humidifiers, switches, recorders, pneumatic transmission systems, and control centers. Write for condensed catalog.

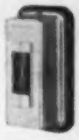
T-901
Submaster Thermostat

R-870
Pressure Regulator

R-317
Air Flow Controller

D-251
Piston Damper Operator

T-800
Capillary Thermostat



T-400
Room Thermostat

V-214
Three-Way Mixing Valve

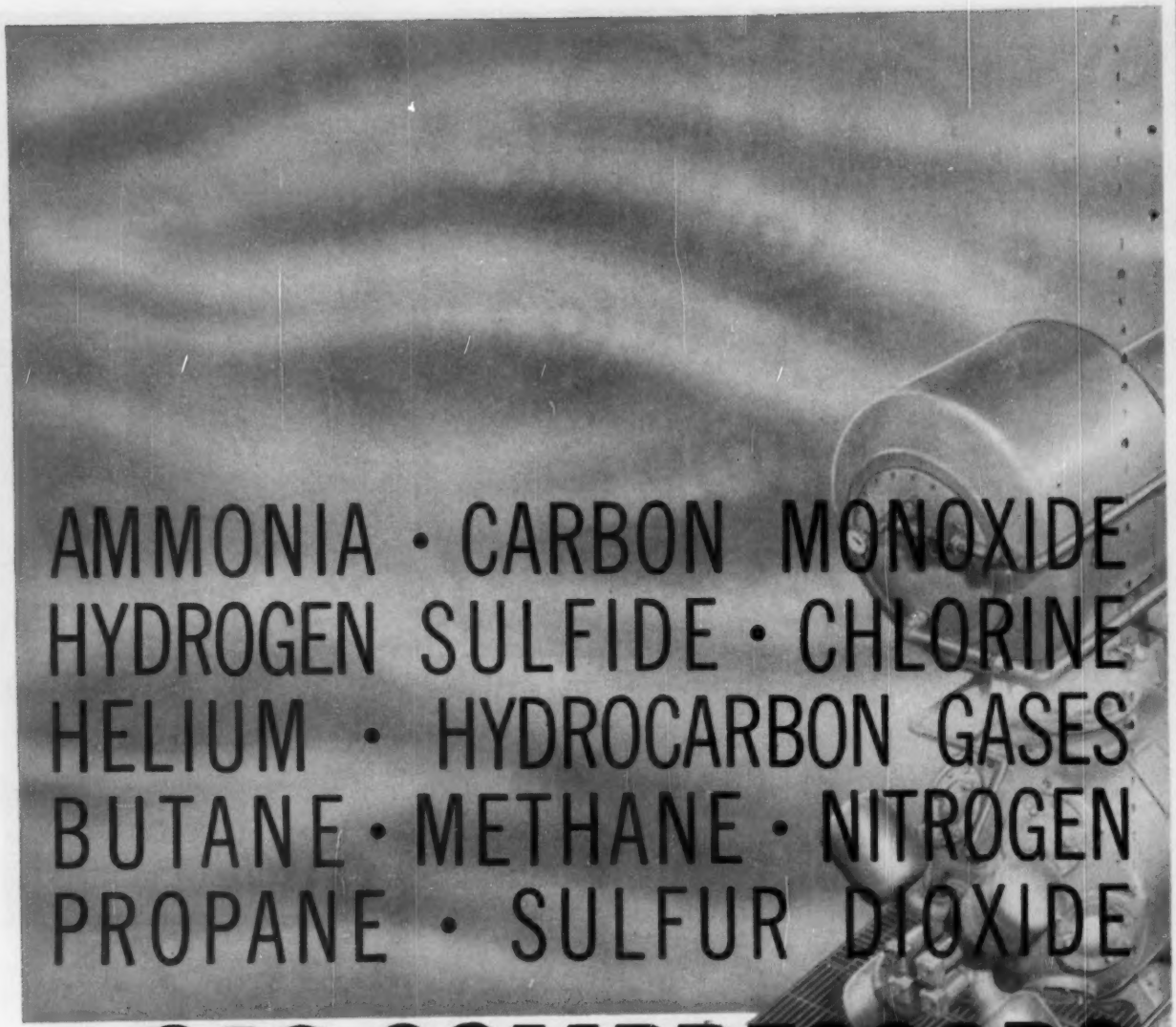
V-257
Three-Way Mixing Valve

JOHNSON CONTROL

PNEUMATIC SYSTEMS

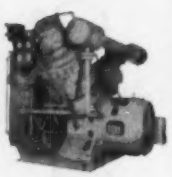
DESIGN • MANUFACTURE • INSTALLATION • SINCE 1885

For more facts circle 226 on Reader Service card, p 103

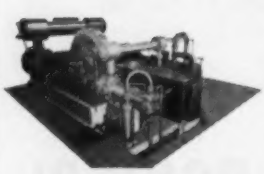

AMMONIA · CARBON MONOXIDE
HYDROGEN SULFIDE · CHLORINE
HELIUM · HYDROCARBON GASES
BUTANE · METHANE · NITROGEN
PROPANE · SULFUR DIOXIDE

GAS COMPRESSORS

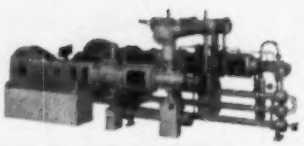
Class "T" (Straight-line Tandem)



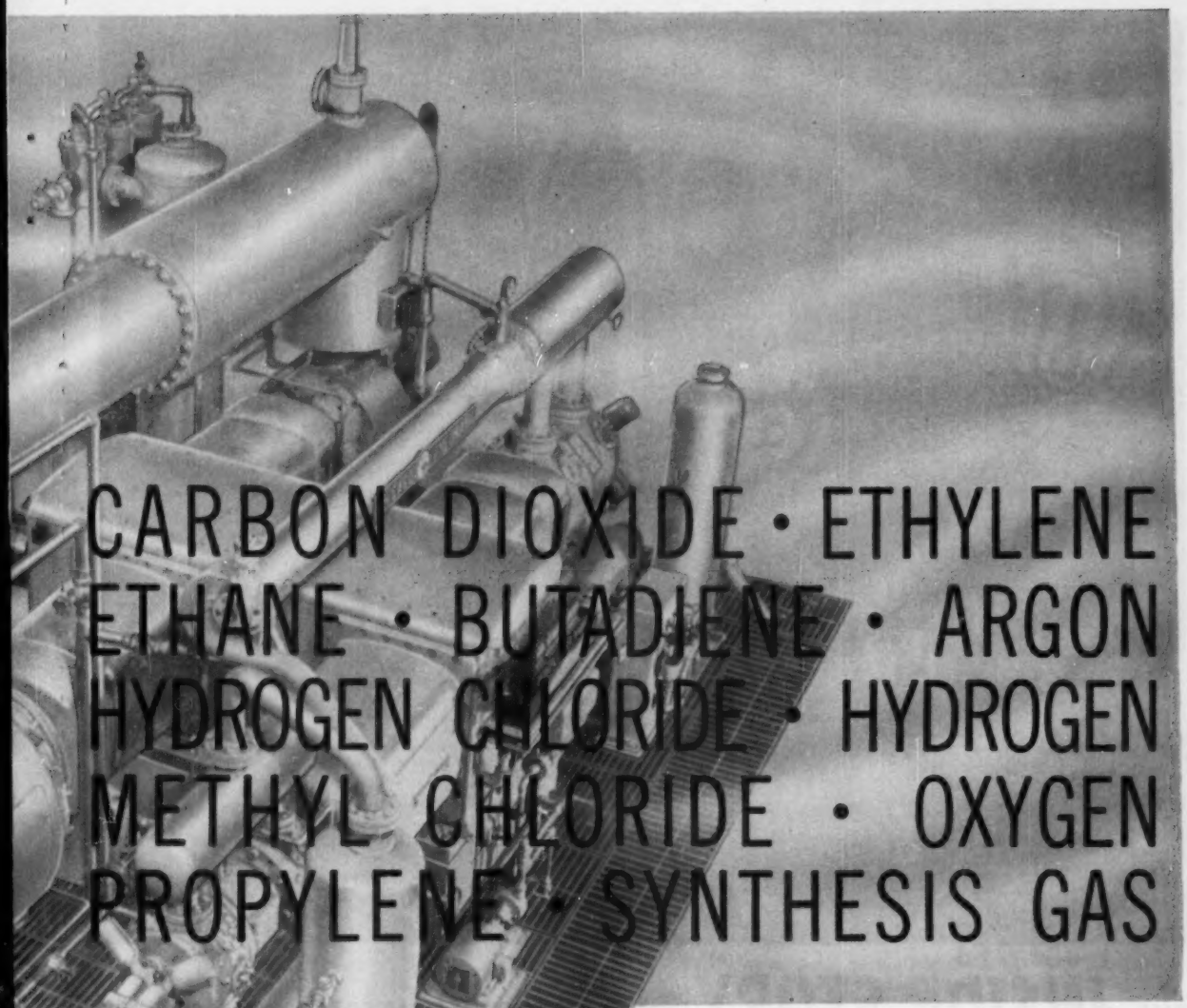
Class "Y"



Class "H" (Four-corner)



Class "O" (Horizontal Duplex)



CARBON DIOXIDE • ETHYLENE ETHANE • BUTADIENE • ARGON HYDROGEN CHLORIDE • HYDROGEN METHYL CHLORIDE • OXYGEN PROPYLENE • SYNTHESIS GAS

Class "FE" (Balanced-Opposed)

are our business

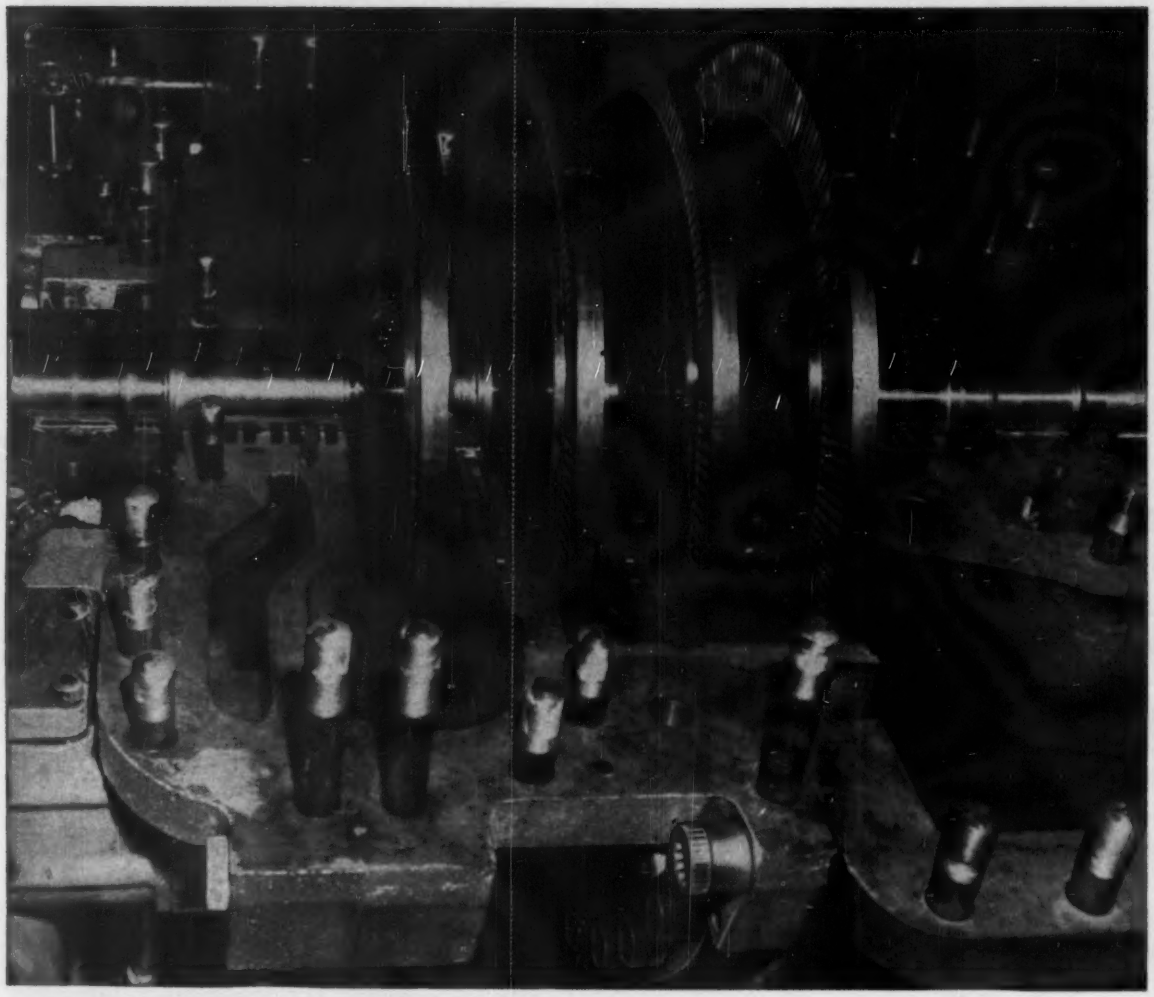
- **Vacuum to 15,000 psig**
- **Sizes to 5,000 h.p.**
- **Motor or steam drive**

There is a CP Compressor to handle most known gases. Each machine is engineered to meet specific job requirements... with special materials, construction, capacity and pressure controls to suit process demands.

Chicago Pneumatic *8 East 44th Street, New York 17, N. Y.*

AIR AND GAS COMPRESSORS • VACUUM PUMPS • PNEUMATIC TOOLS • ELECTRIC TOOLS • DIESEL ENGINES • ROCK DRILLS • HYDRAULIC TOOLS

For more facts circle 227 on Reader Service card, p 103



THE INSIDE STORY OF A MURRAY HIGH SPEED COMPRESSOR

DRIVE TURBINE REVEALS THE REASONS FOR MURRAY'S UNIVERSAL ACCEPTANCE

A look at MURRAY'S rugged construction from the inside shows the husky shaft and heavy accurately formed discs with generous sized hubs designed to withstand the axial and radial stresses imposed by this type of service.

Large-dimension disc rims receive the specially contoured stainless steel blades with the Murray integral shroud. This insures smooth steam passages with maximum strength.

Short bearing spans insure smooth operation and eliminate the hazard of operating in critical speeds.

A look at the heavy flanges and husky bolting in the actual unretouched shop photo shown above bears out the extreme ruggedness that typifies every feature of Murray construction.

Our nearest representative will gladly help you solve your high speed compressor drive turbine requirements. Just write to Murray Iron Works Company, Burlington, Iowa, for his name.

Murray
TURBINES

MURRAY IRON WORKS COMPANY • BURLINGTON, IOWA
Builders of Steam Power Equipment for Nearly a Century

For more facts circle 228 on Reader Service card, p 103

New Series of Marsh Needle Valves in 316 STAINLESS STEEL

—Valves that take you out of your corrosion problems

Now still wider service range for the valves that have set new standards in the needle throttling field. A full line of Marsh Needle Valves are immediately available in 316 stainless steel in the new series 1936.

Identified by **blue handles**

Here is a valve that opens up the wide range of corrosion-resistant applications bracketed by 316 stainless. It is a valve that gives precision throttling at pressures from a few pounds through 6000 psi . . . a valve for any temperature from minus 100° F. to plus 500° F. thanks to the "Marpak" packing system making use of precision moulded Teflon.

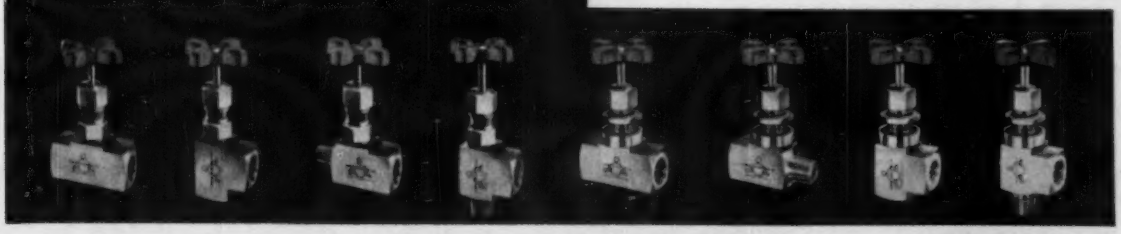
Only Marsh experience—in both valve making and instrument making—could have produced these valves. Like other Marsh needle valves, they are available in globe and angle patterns and in panel mounted types; sizes, ⅛", ¼", ⅜", ½", ¾" and 1". The 316 stainless valves are fully described in Bulletin NV-3.

Marsh Needle Valves are also available in 416 stainless steel (identified by green handles) and in mild steel (identified by yellow handles.)

The Marsh touch—
the precision touch—in every detail

- Body and stem guide machined from 316 stainless bar stock.
- Accurately machined stem, precision ground and rolled.
- Longer inlet and outlet thread chambers insure tight make-up.
- Packing as corrosion-resistant as the valve.

MARSH *Needle Valves*



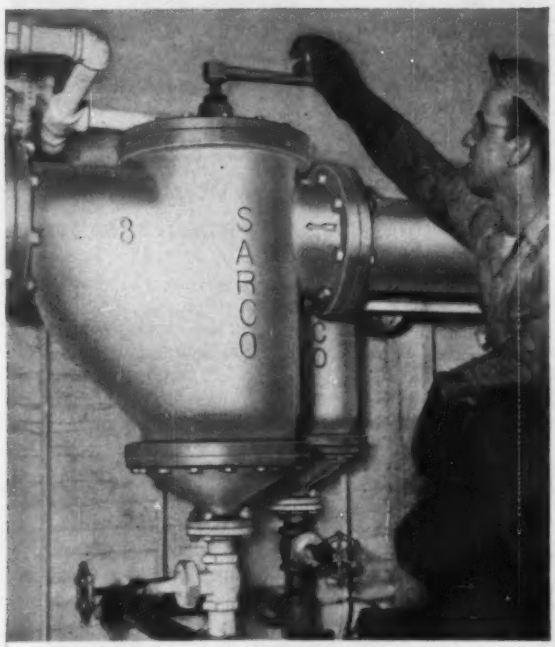
MARSH INSTRUMENT COMPANY, Dept. F, Skokie, Ill.
Division of Colorado Oil and Gas Corporation
Marsh Instrument & Valve Co. (Canada) Ltd.
8407 103rd St., Edmonton, Alberta
Houston Branch Plant, 1121 Rothwell St.,
Dept. 15, Houston, Texas

For more facts circle 229 on Reader Service card, p 103

SARCO TOPICS

How correct strainer selection protects equipment, maintains fluid flow, and prevents shut-downs

Strainers for wash water for power plant condensers cleaned without shut down



Sarco Type VRS Rotary Scraper Strainers enable operators to clear the screens with a few turns of the crank, without shutting down the line or dismantling the strainer.

Sizable quantities of water are required for cleaning condenser water screens at a power plant in California. Sea water is pumped for the purpose and must be freed from debris and sea life such as mussels and sardines. Further, any screening devices used must be capable of cleaning without shut-down.

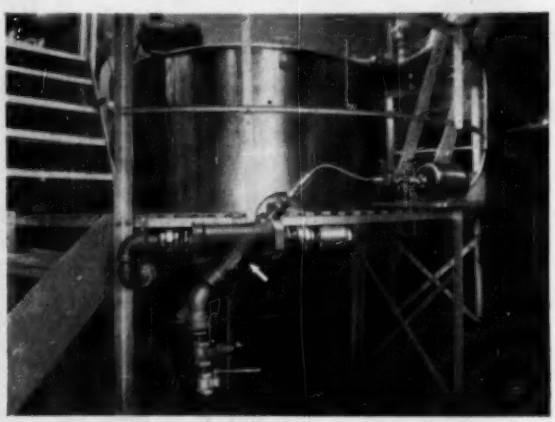
These problems were met by installing two Sarco type VRS scraper strainers ahead of the wash water pumps. This type of strainer is cleaned by rotating a spiral blade either manually or by motor drive. Motor-operated rotary-type strainers make it possible to clean the strainer continuously. The blade scrapes the screen clear, and collected solids are blown down from the strainer as required. Clean screens minimize pressure drop. The Sarco strainer installation has materially reduced maintenance hours and insured against temporary shut-down caused by clogged strainers.

Helical scraper knife clears screen without shutdown in East Chicago Air Conditioning System

Offices of the Inland Steel Company, at East Chicago, Indiana, are cooled with air conditioning units of 7½ tons and larger. Water for condenser cooling is pumped in from Lake Michigan.

Although passing through traveling screens, the incoming water still contained fine sand which clogged the screens. Frequent cleaning was required, and every now and again the units were practically out of service.

Plant engineers found their answer in Sarco Rotary Scraper Strainers, Type VRS. These units incorporate a hand-operated helical scraper knife within the cylindrical strainer screen. These scrapers made it possible to keep the strainers clean simply by cranking the scraper a few turns at regular intervals. Sand scraped off the screen is blown clear and discharged at pressure through a manually operated valve to waste. Now it is not necessary either to dismantle the strainer or shut down the unit.



IN PROCESS APPLICATION This Sarco motor operated-Scraper Strainer, Type SRS, is used to strain chocolate syrup in a processing application, providing continuous flow of fluid without shut-down for maintenance. 2147

For information on Sarco strainers, contact your Sarco sales representative, district office, or distributor; or write—

SARCO

SARCO COMPANY, INC.
635 MADISON AVENUE, NEW YORK 22, N. Y.
PLANT: BETHLEHEM, PA.

STEAM TRAPS • TEMPERATURE CONTROLLERS
STRAINERS • HEATING SPECIALTIES

For more facts circle 230 on Reader Service card, p 103

Do you need this to open the doors to your plant?

IF THE DOORS TO YOUR PLANT ARE HARD TO OPEN . . . IF THEY SLAM SHUT LIKE STEEL TRAPS . . . YOU NEED MAKE-UP AIR.

Slamming doors are just one symptom of a serious problem that can raise havoc with your plant and process efficiency and increase worker absenteeism. Here's why. Exhaust fans take out air along with the dust and fumes, creating a vacuum. Nature abhors a vacuum, so your plant attempts to make up the exhausted air any way it can . . . through doors, around windows and through cracks in the walls. It never quite succeeds so a partial vacuum remains. What does all this mean to you? Combustion processes are starved for air. Your exhaust fans don't work efficiently. Workers are too cold near drafty outside walls and too hot in the center of the plant. These things mean costly, inefficient operation and high absenteeism. Want a free evaluation of your plant's present ventilation system? Call in Westinghouse application engineers, experts on the subject . . . or write for our booklet on **balanced** ventilation. Dept. KPO4, Sturtevant Division, Hyde Park 36, Mass. You can be sure . . . if it's Westinghouse.

Westinghouse

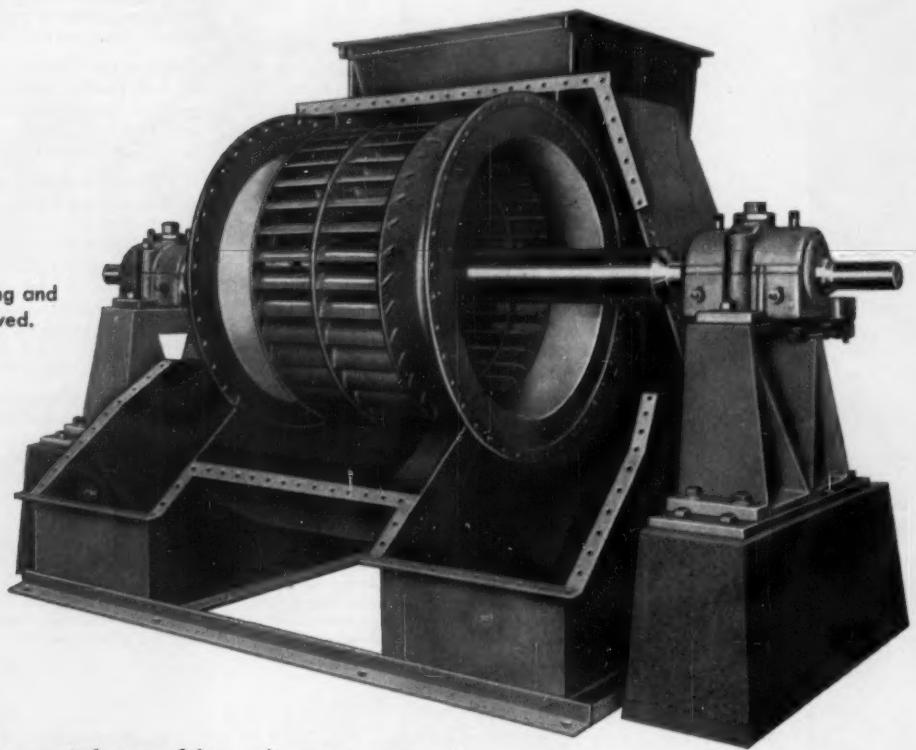
J-80704

For more facts circle 231 on Reader Service card, p 103

Circle 232 on Reader Service card for following ad ➤

CLARAGE

HAS WHAT IT TAKES for induced draft, toughest fan service of them all! The Clarage Dynacurve Fan is built extra heavy for extra service life. Compact design minimizes floor space and height requirements. Rugged wheel has 36 radially deep, aerodynamically curved blades and tapered rims. Optional wearing plates go where they belong—on the **face,** not the back, of the blades. Optional scroll liners are **bolted,** not welded, for easy replacement. Save cost, save space. Choose Clarage.



Sections of housing and inlet boxes removed.

Dependable equipment for making air your servant

CLARAGE FAN COMPANY

Kalamazoo, Michigan

•SALES ENGINEERING OFFICES IN ALL PRINCIPAL CITIES • IN CANADA: Canada Fans, Ltd., 4285 Richelieu St., Montreal

For more facts circle 233 on Reader Service card, p 103

Regenerating Water Softeners Efficiently:

Only one salt dissolver delivers fully saturated brine at lowest cost

It's the Sterling Lixator—a fully automatic rock salt dissolver developed exclusively by International Salt Company for making 100% saturated brine from economical Sterling Rock Salt. It's being used in hundreds of industrial and commercial water softener installations because of its simplicity, economy and trouble-free operation. Here are the Lixator's advantages:

Lixator has no moving parts—nothing to get out of order.

Downflow principle. After water is admitted into the Lixator, it flows *down* through the rock salt in the dissolving zone.

Brine is self-filtered for maximum purity. There is no sand or gravel filter bed to bother with. Instead, rock salt crystals in the lower portion of the Lixator completely filter the saturated brine.

Fully automatic. Whenever brine is drawn off, water is automatically admitted into the dissolving chamber to make more brine. Rock salt flows in from a Lixator hopper or down a chute from an overhead bin. The only requirement is to keep the storage section filled with Sterling Rock Salt.

Great flexibility. The Lixator can be placed anywhere, at a point most convenient for salt delivery. *Pipes* deliver brine to the softeners.

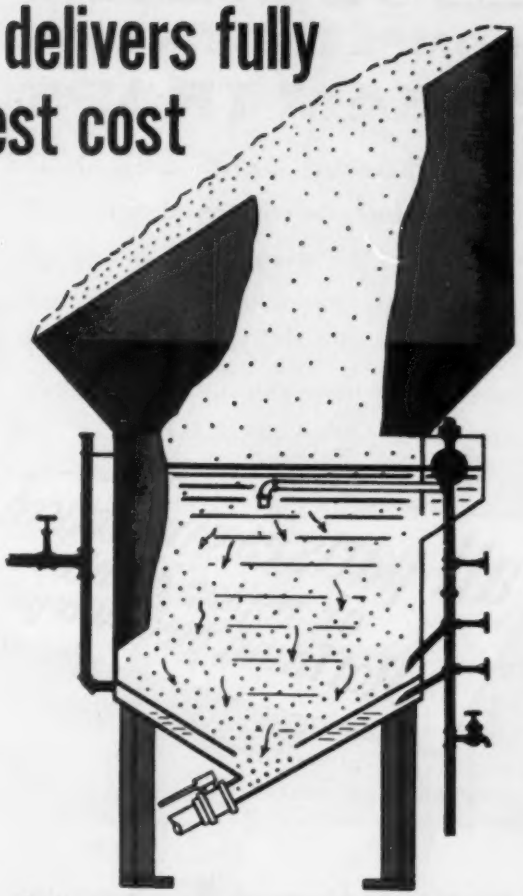
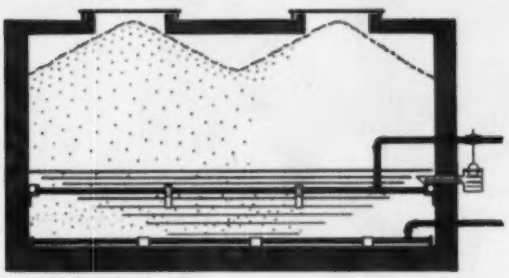


Diagram of Sterling Model Lixator. This is today's most widely used rock salt dissolver. It's available in many standard sizes—from 24″ to 120″ in diameter . . . with brine-making capacities up to 6,000 gallons per hour. Lixators come in enameled steel, Monel metal, or corrosion-proof plastic . . . with storage hoppers (standard low-lip, wall-type, cylindrical, corner, etc.) to suit any plant requirement.

For information on how your plant can save money with a Lixator, contact the nearest International Salt Company sales office. You can also get a free copy of "Brine for Today's Industry"—which fully describes the Lixate Process.



▲ **Diagram of Sterling Storage Lixator.** Designed for larger operations, the Storage Lixator is a combination salt storage, salt dissolving, and brine storage tank. On delivery, Sterling Rock Salt is unloaded directly into the Lixator. Lixate Brine is made automatically, as it is in every type of Lixator.

District offices:
Boston
Buffalo
Charlotte
Chicago
Cincinnati
Detroit
Newark
New Orleans
New York
Philadelphia
Pittsburgh
St. Louis

International Salt Company
Dep't. P-11
Clarks Summit, Penna.

☐ Please have representative call with further information.

☐ Please send free booklet, "Brine For Today's Industries."

*Name*_____ *Company*_____

*Address*_____

*City*_____ *State*_____

INTERNATIONAL STERLING SALT SALT COMPANY

"A STEP AHEAD IN SALT TECHNOLOGY"

For more facts circle 234 on Reader Service card, p 103

HOFFMAN

COMPLETE LINE OF STEAM TRAPS

Hoffman Traps are specially designed and constructed to give economical removal of condensate from steam lines, long in-use life, and easy access for servicing. Traps illustrated are typical of Hoffman's complete line; each has removable cover, pin and seat for quick inspection and cleaning.

LOW, MEDIUM AND HIGH PRESSURE THERMOSTATIC TRAPS

all parts easily serviced* or replaced with Hoffman precision parts

* RENEWABLE THERMOSTAT, VALVE PIN & SEAT.

50 Series Float and Thermostatic Trap for Steam Systems and Equipment. For quick access and ease of servicing, all working parts of Hoffman Float and Thermostatic Traps are attached to trap's removable cover. Once installed, cleaning and repairing is possible without breaking pipe connections.

600 Series Inverted Bucket Traps for Intermittent Draining of Condensate and Air from Steam Equipment. Hoffman Bucket Traps are flexible in capacity; various sized valve seats are available for operation over a wide range of pressures. Valve seats and pins are easily changed to suit uses and service applications.

50 Series F & T Traps feature quick access to all working parts . . . low maintenance costs.

600 Series Bucket Traps feature straight-through pipe connections and changeable valve seats and pins.

HOFFMAN
SPECIALTY MANUFACTURING CORP.
1700 West 10th Street, Indianapolis 7, Indiana

VALVES, TRAPS, VACUUM & CONDENSATION PUMPS, FORCED HOT WATER HEATING SYSTEMS, STOCKED & SOLD BY LEADING WHOLESALERS OF HEATING & PLUMBING EQUIPMENT.

For more facts circle 235 on Reader Service card, p 103 circle 236 on Reader Service card, p 103 ▶

BONUS LIFE

BONUS PROTECTION

from the Boiler Capital of the World

TITUSVILLE WTP

FROM THE BOILER CAPITAL OF THE WORLD

• BONUS LIFE means longer life and less refractory maintenance made possible by Titusville's unique WTP design featuring *65% Black Surface Tube Area coverage on rear wall.*

Titusville's increased black surface tube area means less refractory maintenance through longer refractory life (less down-time for replacement) and a faster steamer.

• BONUS PROTECTION provided by Titusville WTP's *double casing design* solves the corrosive product problem.

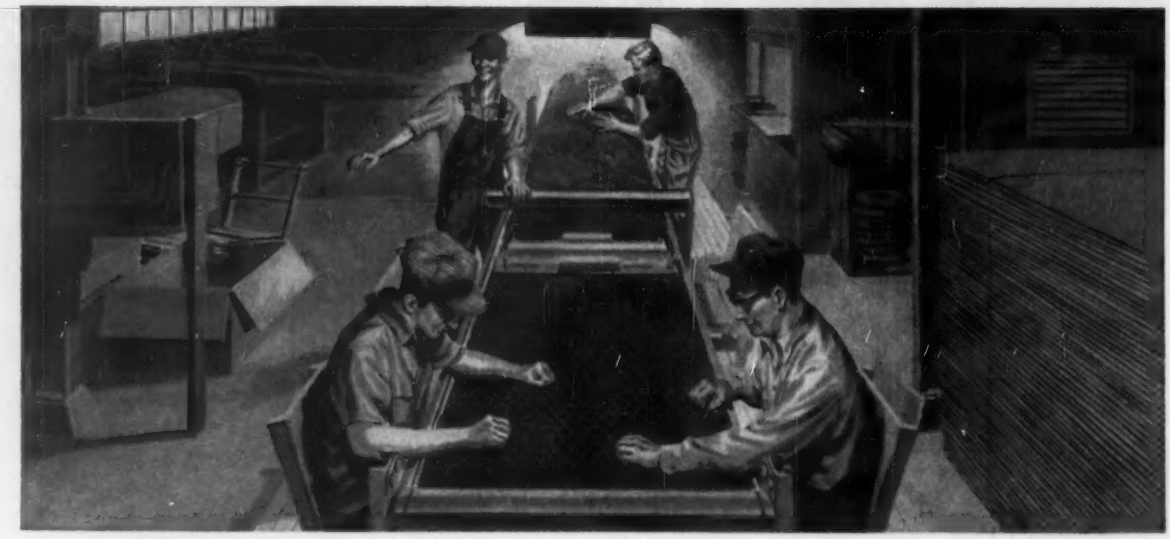
Most water tube steam generators operate intermittently. When dew point is approached at low fire condition, corrosive product can form quickly in single casing boilers.

Titusville WTP's double casing design (with insulation between) reduces temperature differential. Result: formation of corrosive product almost entirely eliminated for many times more casing life.

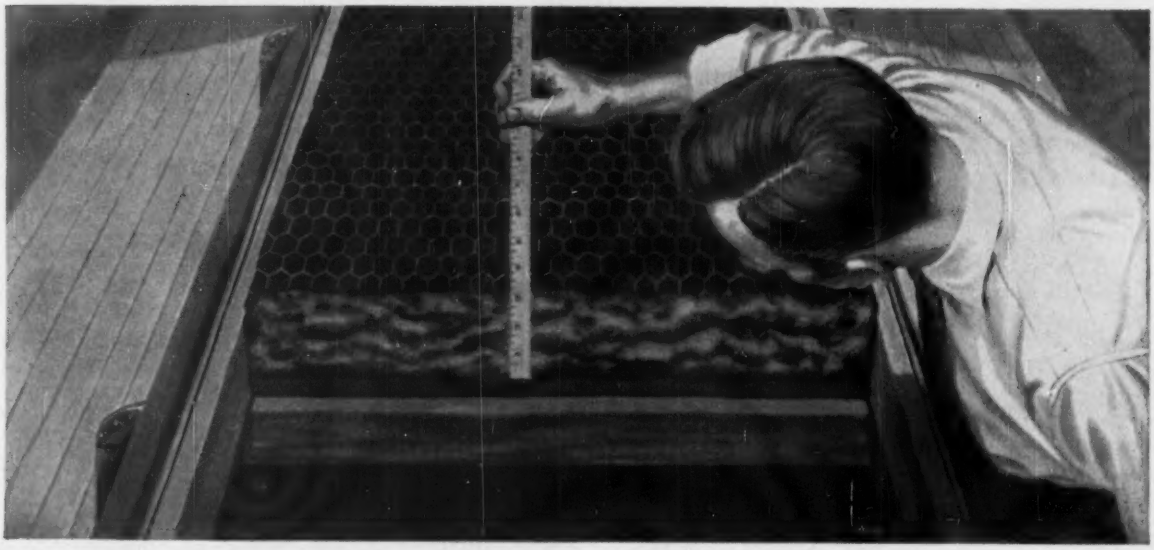
THE TITUSVILLE IRON WORKS COMPANY
TITUSVILLE, PENNSYLVANIA

Division of Struthers Wells Corporation

For your BONUS LIFE and BONUS PROTECTION specify WTP from Titusville



FACTORY FABRICATED TO RIGID SPECIFICATIONS!

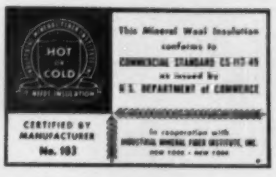


Don't risk efficiency with careless, made-on-the-job blankets.

- Copper bearing steel laths, bound by uniformly spaced soft-drawn galvanized tie wires, keep blankets firm but flexible.
- Eagle-Picher mineral wool evenly dispersed over entire insulating area of each blanket.
- Completely free of large voids usually found in field-made blankets where insulation is haphazardly packed in place.
- Smooth edges butted tightly together eliminate cracks and loose joints.
- Quickly applied to flat or slightly curved surfaces of any large equipment—or cut to fit irregular areas.
- Maximum thermal efficiency at temperatures as high as 1200 F.

Eagle-Picher produces a complete line of industrial insulations for all temperatures from below Zero to over 2000 F.

EAGLE-PICHER
BLANKET INSULATION



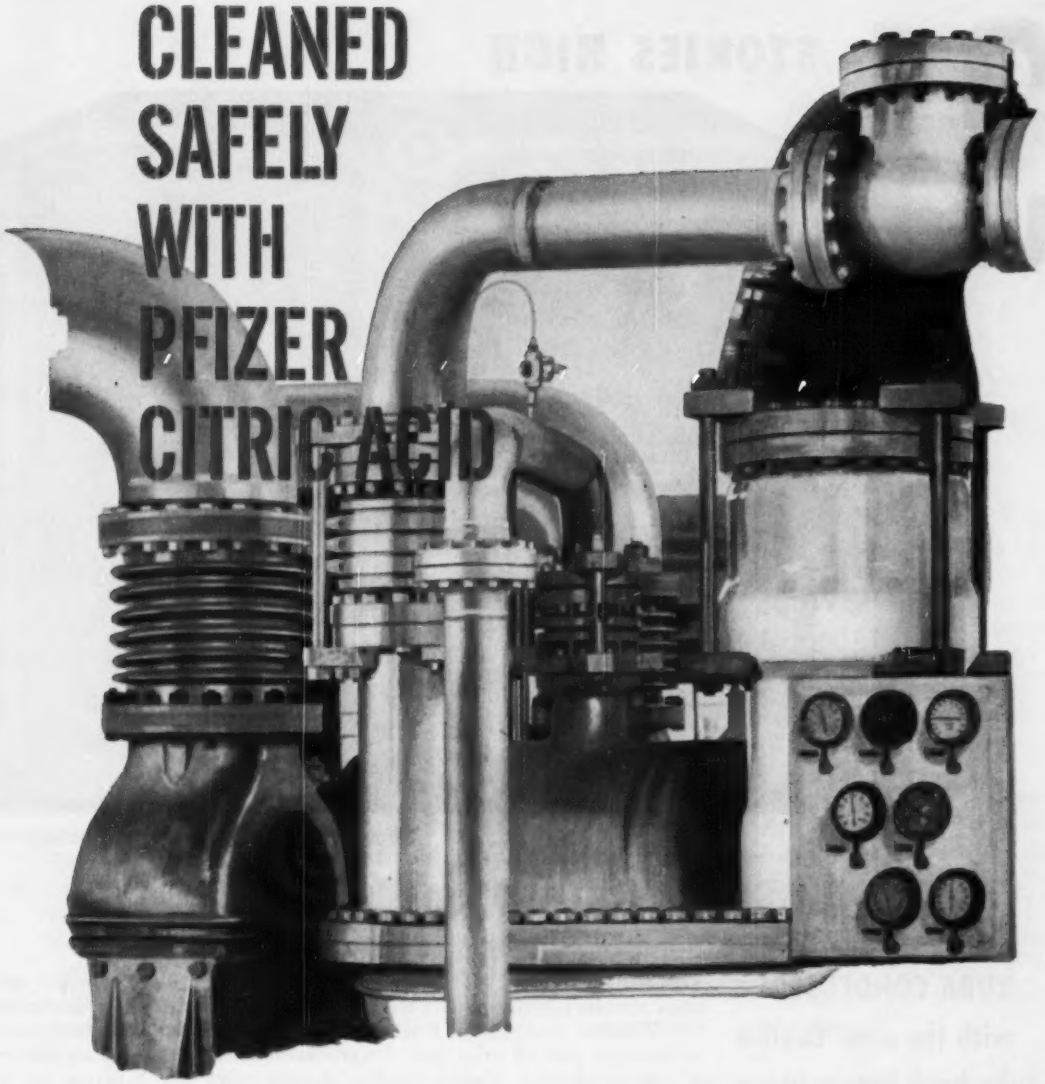
FREE SAMPLE!
Write today!

Since 1843
The Eagle-Picher Company
Dept. P-1160
Cincinnati 1, Ohio

EAGLE EP PICHER

For more facts circle 241 on Reader Service card, p 103

CLEANED SAFELY WITH PFIZER CITRIC ACID



STAINLESS STEEL BOILERS, HEAT EXCHANGERS, ATOMIC INSTALLATIONS, CHEMICAL PROCESSING EQUIPMENT CLEANED SAFELY, EFFICIENTLY WITH PFIZER CITRIC ACID

● Industry experience proves that citric acid eliminates chloride stress corrosion problems — provides effective descaling — permits easier, more efficient after-rinsing.

Discuss with your chemical cleaning service company these advantages of Pfizer Citric Acid in stainless steel cleaning solutions:

1 Citric acid is highly efficient in removing imbedded metal and oxide films from stainless steel.

2 Citric acid's excellent sequestering ability prevents reprecipitation of dissolved scale.

3 Citric acid cleaning eliminates the problem of chloride stress corrosion.

4 Citric acid can be effectively inhibited without losing its cleaning or sequestering ability.

5 Citric acid is sold as a dry, 100% acid — meaning savings in storage and handling.

6 Citric acid is water soluble, easy to handle, and non-toxic.

Let us send you further information, cost and obligation-free!

I want to learn more about the use of Pfizer Citric Acid for cleaning stainless steel equipment. Please send me Technical Bulletin 102.

Name_____

Company_____

Address_____

City_____ Zone____ State_____

Science for the world's well-being

Manufacturing Chemists for Over a Century

Pfizer

CHAS. PFIZER & CO., INC., CHEMICAL SALES DIV., 630 FLUSHING AVE., BROOKLYN 6, N. Y.
Branch Offices: Clifton, N. J.; Chicago, Ill.; San Francisco, Calif.; Vernon, Calif.; Atlanta, Ga.; Dallas, Tex., Montreal, Canada

For more facts circle 237 on Reader Service card, p 103

3 STORIES HIGH

200,000 sq. ft. condenser for Widow's Creek Station of TVA

or BROAD and LOW

YUBA CONDENSERS—with the most flexible tube bank layout in the industry—designed to fit any plant or space requirements

This is a three story high, twin-bank condenser—just one of many tube bank layouts possible with Yuba Condensers—most flexible in the industry. Whether you require a giant condenser or a small one, in a single or multiple pass or axial flow design—no matter what the size, type or service conditions, Yuba's flexible design paces the progress in the power industry.

Yuba's twin-bank tube layout, for example, permits turbine exhaust steam to flow unobstructed, with equal distribution throughout the entire tube bank with a free flow to bottom of condenser and into hotwell, where it reheats and deaerates condensate. In Yuba's deaerating condensers, the oxygen in the condensate is guaranteed to be less than 0.005 cc per liter. This design is patented.

For that extra performance, Yuba staggers the tube support plates—reducing harmonics—eliminating vibration. This is just another reason Yuba surface condensers have been installed all over the world in plants of many sizes. For full details, contact Yuba today.

Other Yuba products for steam power plants include Feedwater Heaters, Evaporators, Expansion Joints, Cranes, Tanks, Structural Steel and scores of other items.

YUBA

specialists in power plant equipment

YUBA HEAT TRANSFER DIVISION
4th and Main Streets, Honesdale, Pennsylvania

YUBA CONSOLIDATED INDUSTRIES, INC.

Sales Offices in Atlanta • Buffalo • Chicago • Cleveland • Houston • Los Angeles • New York • Philadelphia • Pittsburgh • San Francisco • Seattle

LOUIS N ROWLEY, EDITOR • NOVEMBER 1960 • ESTABLISHED 1882 **Power**

What price engineering?

As you might guess from the above, I'm not yet done with the subject of equipment purchasing. One more point needs to be added to those discussed on this page in the past two issues: the increasingly important matter of engineering costs.

Now I'm not talking about the engineering that goes into the design of a specific piece of hardware —what might be called *product engineering*. Nor do I mean the plant design work often done by consultants and paid for on a fee basis. At this point you might well ask, "What kind of engineering *do* you mean?" Let me try to explain.

More and more we apply the "systems" approach. We buy a water-conditioning system, not just a water softener. A coal-handling system, not just a conveyor. A combustion-control system, not just a damper regulator. This isn't a case of using fancy words—the differences are real and there are good reasons for them.

There was a time when combustion control, for example, involved little more than a damper regulator—a single piece of hardware. Today, the control of combustion involves a variety of sensing and actuating devices, electric or pneumatic power to operate the control elements, instruments and meters to indicate and record performance. These many items of hardware must be skillfully integrated into a *system* that will accomplish the desired control objectives with maximum effectiveness. This is the engineering I'm concerned about here.

Why is it important? For one thing, because as our energy-conversion operations become more sophisticated, the amount—and cost—of such systems engineering becomes greater. Not infrequently, engineering may be a major element of total cost. And herein lies cause for concern.

Not because good systems engineering isn't worth every penny it costs—it is, and the quality of the engineering may make all the difference between an effective system and a poor one. The problem arises out of the fact that this cost is essentially intangible. We see the hardware, but we can't see the brains that have gone into coordinating it into a system tailored precisely to our requirements and objectives.

We all know that this kind of engineering cost is real and worthwhile. It would exist even if we bought the hardware separately and integrated it into a working system ourselves. Most of us, however, recognize the wisdom of entrusting this engineering to specialist suppliers who take responsibility for delivering a complete system to meet our specifications. So the problem enters when we compare two or more proposals.

Here is one complete system—say a control system—and a price. Here is another, containing roughly the same amount of hardware and carrying a substantially lower price. The risk lies in the temptation to buy on price, without careful evaluation of the system engineering, which may account for most of the difference in price *and in results*.

Such evaluation is not easy to do and not easy to explain to nontechnical management. But again I say that it is a responsibility that we cannot abdicate. We must recognize that systems engineering cost is a real and increasingly important element of total cost. We must be prepared to evaluate it with even greater effectiveness as the growing complexity of energy conversion makes such systems engineering ever more vital in terms of the actual performance value we secure for the dollars we invest in plant and equipment.

ENGINEERED PRODUCTS

for Plant Maintenance

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Now, more than ever, plant engineers and maintenance men specify Garlock PK MECHANIPAK* Seals, LATTICE-BRAID* Asbestos Packings and GUARDIAN* Gaskets for safe, long lasting prevention of equipment failure due to high pressures and temperatures.

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For more facts circle 239 on Reader Service card, p 103

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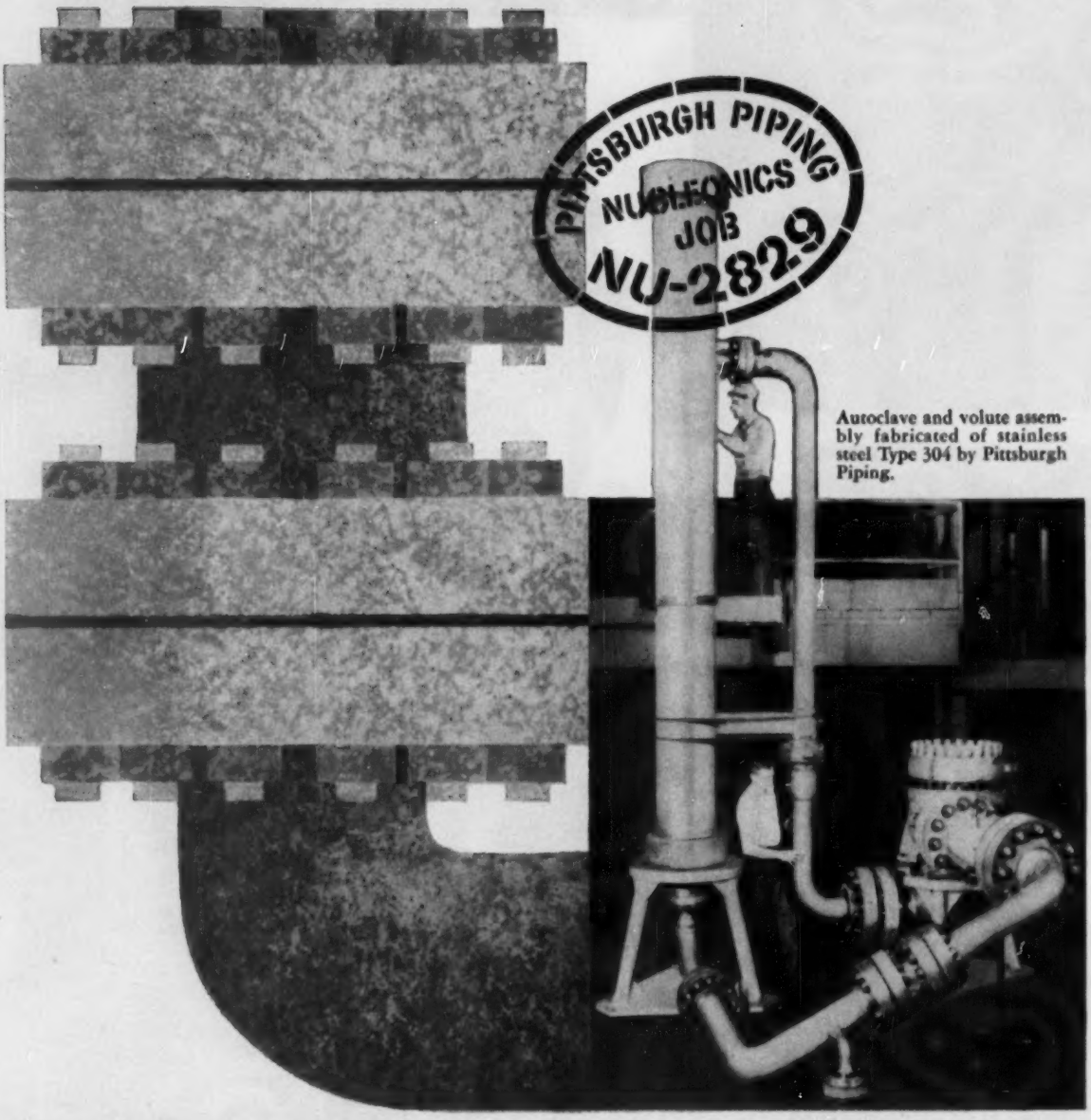

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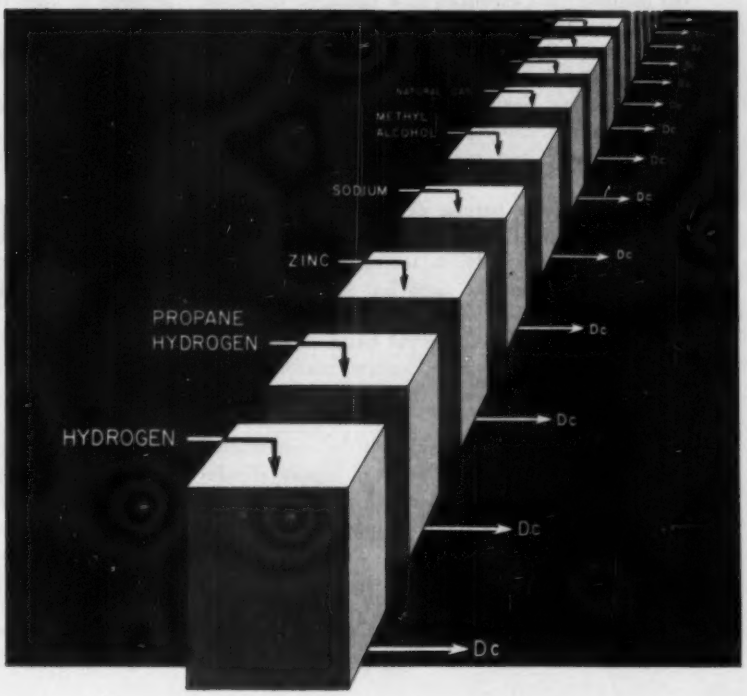
Design and equipment application section

B G A SKROTZKI
Associate Editor in Charge



FUEL CELLS: a big push gets bigger

While industry is aiming for the line between too-broad and too-narrow vision, fuel cell R&D is outspending last year's $35 million in corporate funds. One big goal: a low-temperature low-pressure hydrocarbon cell

By J J O'CONNOR, Managing Editor

- There is little agreement on when present researching in low-pressure low-temperature cells will make impact. Experts think it will precede wide commercial use of thermoelectrics or thermionic converters
- Military applications are being made now. First uses in industry will be portable low-power sources
- If and when we have a cell for large stationary energy supplies, it will probably be a high-pressure high-temperature device using hydrocarbon fuel

Turn page ▶

Just what is a fuel cell?

There's far from firm agreement on just what are the defining characteristics of a fuel cell. Common base is the fact it's an electrochemical cell having a dc output. But when we talk about inputs, there is difference of opinion. Some feel a fuel cell is an electrochemical device in which the chemical energy of a *conventional fuel* is *continuously* converted directly and usefully into *low-voltage* dc output.

Perhaps a more precise definition would ignore the type fuel input (who can say what we call *conventional* today will be so tomorrow?) and back off somewhat from the need for continuity. This would allow inclusion of a device offering long-term operation on a batch fuel-input basis. Many stand pat on the continuous input feature, reasoning that if this is missing we have, in effect, a battery with a replaceable electrode.

For this report we will sidestep the conventional fuel requirement and continuity of supply stipulation. So we wind up with an electrochemical cell capable of converting input fuel directly into low-voltage dc at high efficiency.

Built-in simplicity plus inherent high efficiency are prime attractions of this quiet, clean, static energy converter. As you will shortly note, there are many kinds of fuel cells. They may be classified according to their developers, the fuel used, temperature of operation, whether the cell is slated for special applications or possibly contending as a central electric source. One thing looks pretty certain at this time: only a hydrocarbon fuel will be low enough in cost to be considered for possible central electrical supply application. For special applications, hydrogen or hydrocarbons other than natural gas—this would include propane, butane, kerosene—look promising as possible contenders. Even methyl alcohol may be used.

How does it work?

To study the cell's internal workings let's use the hydrogen-oxygen cell as a model. Here we have a set of porous carbon electrodes with hydrogen fuel gas fed through one, oxygen through other.

In passing through the electrode, the hydrogen molecule is lightly attached *(chemisorbed)* to the electrode's catalyst. At this point the molecule splits into two separate chemisorbed hydrogen atoms. Working in the reverse direction through the electrode are hydroxyl (OH^-) ions developed from the potassium-hydroxide electrolyte. Here's the key: with catalyst present, the chemisorbed hydrogen atoms and the diffused hydroxyl ions combine to

In recent years the long-sought goal of getting usable electric power from a static black box, with little fuss and at high efficiency, has come a great deal closer to reality. In the past 15 years there have been two main avenues of approach followed in attempting to solve the fuel-cell riddle—the classical study of high-temperature cells with the possible consumption of hydrocarbon fuels and the more recent researching into low-temperature systems using fuels such as hydrogen.

Classification of fuel cells is tough. Some split the package into high and low temperature, others according to the fuel used, still more classify according to electrolyte. Rather than agree or differ, we chose to report on progress being made according to the basic cell elements: the electrodes, electrolytes, fuels and finally, a discussion as to temperature and pressure the cell will operate in.

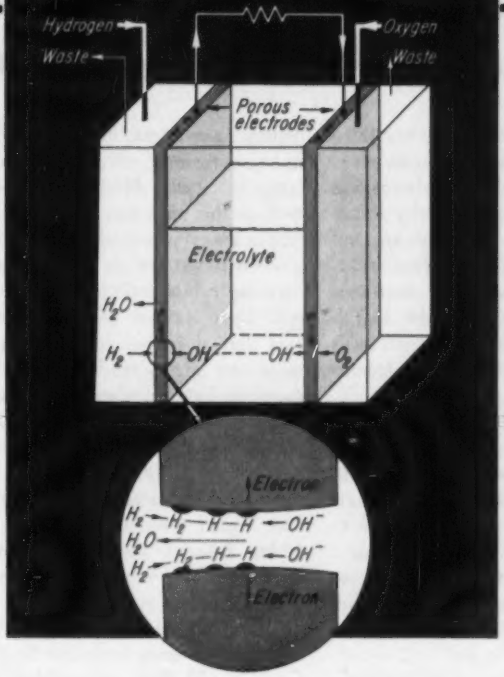
Electrodes serve a three-fold purpose in any cell: store the necessary catalyst, provide a suitable area for reaction, act as an electron pickup point. For reasonable life expectancy, electrode materials should be corrosion-resistant and nonreactive in themselves. This is essential to sidestep electrolyte contamination and unwanted reactions.

Low-temperature cells have made successful use of porous carbon. The built-in advantage of carbon lies in large internal surface area resulting from porosity. But, on the other hand, flooding poses a problem if the carbon is not treated with a paraffin or plastic.

Overloading is always a consideration since water tends to form in the reaction zones faster than it can normally be removed. If too much water forms, pores may be flooded permanently, so cutting down effective electrode reaction area. According to Karl Kordesch of Union Carbide, their low-temperature low-pressure cells are not subject to electrode attack by electrolyte or oxidation. The only real life-limiting factor is wetability of the carbon electrodes. And tendency of the electrode to wet appears to depend on the potential at which the electrode operates rather than absolute operating current density. Improved repellents and more active catalysts have brought performance into the 50 ma/cm^2 range at 0.8 v for over a year's operation with further improvement indicated.

Electrodes of porous metal have been mainly nickel and some stainless steel. England's Bacon used porous nickel electrodes which show decided advantage at higher temperature where nickel displays catalytic qualities.

Electrolytes used to date are many, yet each serves a common function: carry ions from one elec-



form water and release an electron into the electrode. Water in turn is either dissolved back into the electrolyte or dribbled through the fuel gas.

Catalyst at the hydrogen electrode serves to decrease activation energy needed to start the reaction while acting as a bonding surface where the hydrogen molecule chemisorbs and splits and then wanders on into the reaction zone.

Heart of the electrochemical process is dramatized in enlarged electrode drawing, left. Visualize this segment (lower circled portion of complete drawing) as a greatly enlarged electrode pore structure with hydrogen gas to the left and hydroxyl ions to the right.

In a real-life cell, if the gas pressure becomes excessive, fuel gas will be blown right through the porous electrode into the electrolyte without getting a chance to react. On the other hand, should fuel gas pressure drop too low, the electrolyte will flood through the pores covering reaction surfaces.

At the oxygen electrode, after chemisorption, the oxygen travels to the catalytic reaction zone. At this point the oxygen mates with two returning electrons in the electrode and one water molecule extracted from the electrolyte. Result is a perhydroxyl (O_2H^-) along with a hydroxyl (OH^-) ion.

Hydroxyl ion passes into solution replacing one of two hydroxyl ions being used at hydrogen electrode. With the right catalyst in oxygen electrode, the O_2H^- is split into a hydroxyl ion and a free oxygen atom. Former goes into the electrolyte. O_2 is released for later use.

trode to another. In the higher-temperature cells, molten carbonates, molten salts and even mixtures of lithium hydride and lithium chloride have been used. But their inherent high resistance plus a string of other drawbacks indicate need for much further work before suitable high-temperature electrolyte materials are made available.

Potassium hydroxide has been the widest used in low and intermediate temperature areas. Although hydroxyl ions are readily obtained, potassium hydroxide has several disadvantages, primarily that of dilution when used in a cell forming water. Precipitation may also be a problem in some operating conditions. Ion-exchange membrane serves as an electrolyte in the GE cell.

Fuels for the truly practical cell must be readily available at low cost, and operate in combination with air. Hydrogen converts to electricity at

Electrode catalyst: a well-kept secret

As outlined above, the catalyst contained in the fuel electrode plays a most important role. In addition to preparing the molecular fuel by splitting into atoms, it chemisorbs fuel molecules into the electrode surface. But the catalyst used must steer clear of chemisorbing atoms and molecules other than those desired, or of poisoning results. This business of fuel electrode catalysts is generally a well-guarded secret. But there is some indication that noble metals and their alloys are suitable catalysts for hydrogen, some hydrocarbon fuels.

It is reported that Esso Research & Engineering Co has successfully worked with ethane, propane, ethylene and methanol. However, their ultimate goal is to use a regular distillate in a fuel cell. Secret in what they have done so far lies in mixing adequate catalysts into the material used to make the electrodes. But much remains to be done in the development of catalysts before cells will operate practically on conventional petroleum fuels. A sizable research program is also under way to develop satisfactory catalysts that will make it possible to bring cathode size down.

Paired with dc motor, fuel cell poses interesting possibilities

the tune of one-eighth of a lb per kwhr. Carbonaceous fuels in the form of gases are a prime consideration in the work being done by Chambers at Sondes Place Research Institute in England. Objective here is to develop general-purpose fuel cells to operate on conventional gaseous fuels—manufactured gas, natural gas, vaporized liquid hydrocarbons.

Probably the most interesting development in the fuel area came last year in this country when Allis-Chalmers announced they had a fuel-cell-powered tractor working on the rolling hills of Roberts Golf Course in Milwaukee. By banking over 1000 foot-square cells, they produced a total electrical output of 15 kw. Significant contribution to the technology at that time was the gas fuel used: a mixture of gases, *largely propane.* The test run, conducted under the guidance of now deceased Dr Harry K Irig, sent the tractor operating for some 17 minutes on one-third gal of fuel and at 60% efficiency.

Since that time Allis-Chalmers has indicated they were successful in decreasing cell size but they are not divulging further data on fuel make-up. And it's in this latter area that most interest lies. To be able to utilize on a continuous and efficient basis a readily available low-cost hydrocarbon is the ultimate goal for many.

Low fuel cost is largely determined by high efficiency, provided low-cost fuels are used. In cells, thought of in terms of large blocks of power at low cost, it may eventually be possible to reach overall efficiencies much greater than the 40% now realized in the steam turbine-generator plants. But fuel cell efficiencies taken alone can be misleading.

An overall efficiency of 90% sounds impressive but is scarcely worthwhile if available only at current densities so low as to be impractical. Low capital investment, long life and low upkeep are most uncertain today for large fuel cells. Hydrogen is widely used in fuel cells being developed but it has many practical limitations.

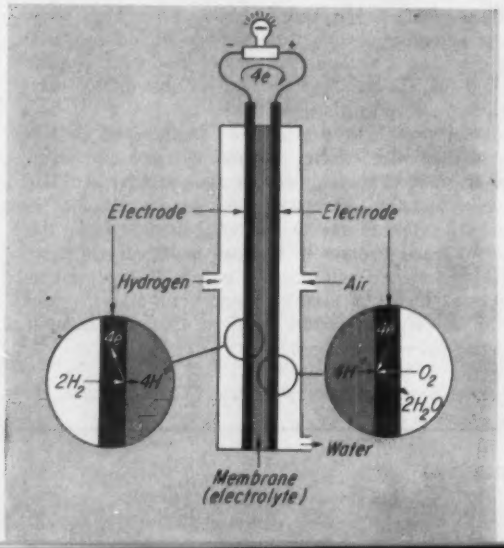
Temperature is becoming increasingly interesting to cell developers. Basic reason is the elementary fact that at higher temperatures gas molecules are more active, thus increasing rate of chemisorption and molecular cracking. Temperature levels of low (20 to 100 C), medium (up to about 500 C) and high (600 to 1000 C) are practical groupings. The higher temperatures open up a wider area of possible fuel utilization to include ethane, propane, carbon monoxide, among others.

Two cells developed to relatively high-performance levels are the Union Carbide (70 C at atmospheric pressure) and the Bacon cell (200 C at 400 psia). The many cells available are generally tagged with the follow-

Ion-membrane hydrogen-oxygen cell bids for military needs

One of the many fundamental problems facing the fuel cell designer is how to get enough fuel-electrode-electrolyte reaction sites in any given volume. As shown on the previous page, a 3-way action takes place at electrode of a typical hydrogen-oxygen cell.

GE's ion-exchange membrane claims to have solved the triple-contact stability problem by eliminating the liquid phase entirely. All reaction sites are set through use of solid electrolyte, a plastic membrane permitting hydrogen ions to migrate from one electrode to the other. As shown at left, hydrogen and air enter chambers on opposite sides of the ion permeable membrane and penetrate the porous electrodes to contact membrane surfaces.



On the hydrogen side of the cell electrons are given up, collected in the electrode and conducted to the load. The hydrogen ions travel through the solid electrolyte to the other surface of the membrane where they combine with the returning electrons in the presence of oxygen. Result is the formation of water and release of useful electrical energy. Water droplets form on the open-air side of the cell and drain off.

An interesting feature is the ease of reversibility: applying an electric current lets cell electrolyze water producing fuel and oxidant for later use.

Today this device is slated for the military, to power communications and radar equipment. Each fuel cell produces about one volt. And since output depends on membrane area, cells are being produced from 16 to 144 sq in., with apparently no theoretical limit on membrane area.

in combining static supply with simple scheme for variable speed

ing names: *Hydrox*—low- or medium-temperature hydrogen-burning cell; *Redox* — reduction and oxidation processes take place in intermediate substances, then pass over inert electrodes *molten salt* — high-temperature salts for electrolytes; *Carbox*—high-temperature carbon-oxygen fuel-cell system.

Work with high temperatures has given an insight into the broad field of electrochemical reaction kinetics. It is the hope of some that improved catalysts may permit present high-temperature reactions to be achieved in low-temperature cells.

Cell output, regardless of specific technology followed, will be low-voltage direct current. Using a simple series-parallel arrangement, higher voltages with increased capacity can readily be had. And the inversion from dc to ac is no difficult problem. Inversion may be carried out by either rotating or solid-state equipment using present-day technology.

Even at this early date, cell developers are molding marketing plans. General Electric, as a case-in-point, are handling their ion-exchange membrane cell out of the Lynn, Mass. plant, since the organization here is particularly well-oriented for dealing with the military. When it materializes, the industrial and commercial area will be funneled through GE's dc-mg people in Erie, Pa.

What's ahead? Somewhat akin to the internal combustion engine at the turn of the century, the fuel cell has its followers and doubters. Big lure is efficiency, simplicity, possible economies of channeling chemical energy into electrical without the intermediate steps in use today. Long-range fuel-cell acceptance hinges on utilization of hydrocarbon fuels. Many look upon the fuel cell as one possible answer to the growing problem of air pollution resulting from automobile-engine exhausts.

As with other power supplies, fuel cells can be designed to optimize a broad variety of characteristics—weight, volume, initial cost, operating cost. Typical: when a cell is operating with low power output, fuel efficiency is high, fuel costs low, but larger cells must be used to meet power requirements so first cost is high. When operating the cell at high power outputs the opposite is true.

In a report just released (*Fuel cells: Power for the Future*, available from Fuel Cell Research Associates, PO Box 157, Cambridge 38, Mass., $18.75) a technical and economic analysis is made of developments and opportunities in fuel cells. Based on field consultation with more than 30 firms, a carefully evaluated technical analysis was made with emphasis on present limitations and areas where breakthrough can be expected. It's recommended reading.

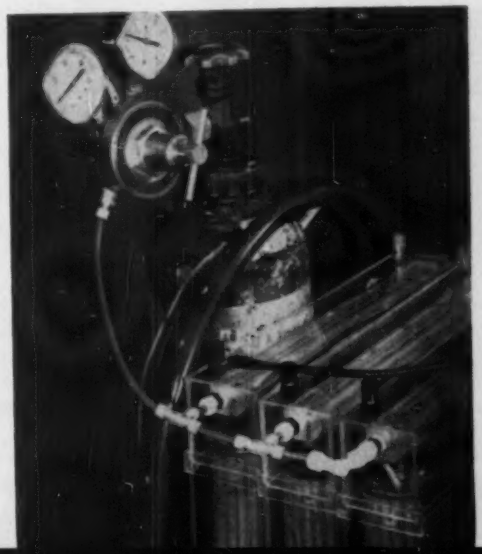
Zinc-oxygen cell slated to power industrial electric trucks

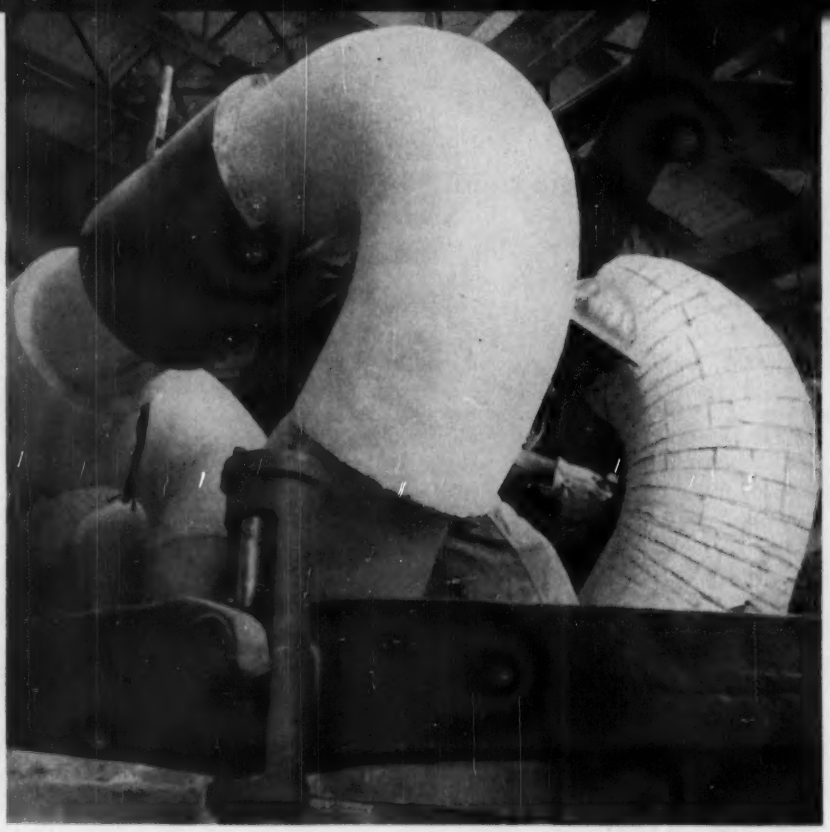
Earlier this year, the Electric Storage Battery Co signed agreements with 12 of the nation's materials-handling equipment manufacturers. The aim: jointly develop an adaptation of the present Exide fuel cell. Exide feel they are well beyond the basic and applied research stages in the development of at least one type of fuel cell, a rechargeable zinc-oxygen unit that they believe foreruns other cells.

Through use of zinc as a fuel, compressed oxygen as oxidizer, Exide has produced a cell for operation at nearly normal temperatures and pressures with no waste products to be removed. Zinc is oxidized in a potassium-hydroxide electrolyte as oxygen is admitted under low pressure.

Looking upon fuel cells as an advanced type of storage battery, this type cell should be able to feed industrial trucks on heavy-duty operation for 16 to 24 hours before cells need be recharged. Cells can be recharged electrically. If there is need to operate the vehicle continuously, another design can be adopted in which the zinc electrode can be removed and charged outside the cell or replaced in its entirety. Zinc oxide of the discharged zinc electrode is valuable recoverable material that can be turned in for credit, an important practical consideration.

Critics of the Exide cell question whether a zinc cell is a fuel cell. If we use the narrow definition limiting fuel cells to conventional fuels, the reversible Exide cell would not be a contender. But, in same light, neither would most others since it is hard to consider hydrogen as a "conventional" fuel.





MAIN PIPING to turbine gets two layers of specially molded insulating material. Steam conditions are 2475 psig, 1053 F at throttle of the unit →

Material selection to provide tight balance between amortized costs and savings through reduced heat losses was key consideration in . . .

Insulating an 862.5-mw plant

By D H KREGG, Project Mgr, Burns and Roe, Inc

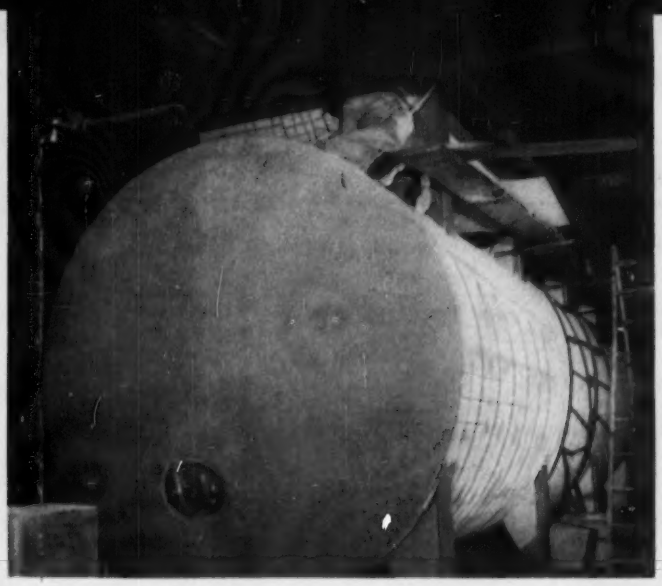
The City of Memphis Light, Gas & Water Division's new Thos H Allen station is successful evidence of the design concept which provides economical operation with utmost reliability. Performancewise it boasts a heat rate of 8860 Btu per kwhr which compares very favorably with the national average of 11,370. And when completed it claimed the distinction of being the largest steam power plant ever authorized at one time by any municipality.

Design approach stipulated that only the most modern equipment and materials with proven service records would be used. Aware that controlling heat loss by proper thermal insulation is a vital factor in holding the line on power-production costs, designers used materials providing careful balance between amortized costs and savings due to reduced heat losses. Insulation selected for each piece of equipment had the lowest thermal conductivity factor and the greatest thickness consistent with the economics involved, see table I.

Insulation work was divided into three categories: (1) steam generators (2) main steam lines to turbines and (3) remainder of plant auxiliary equipment and piping. Mineral wool was used for boiler insulation; calcium silicate was applied to the main steam lines and a variety of other insulating materials, such as glass fiber, cork, asbestos and mineral wool were used throughout the plant.

Principal purpose of all insulation was, of course, to prevent heat-energy loss. However, some piping and equipment was lagged strictly to protect plant personnel. All surfaces with operating temperatures above 140 F located where individuals might come into contact with them were covered with insulation to prevent burns.

Minimizing insulation cost. A pipe-surface temperature of 550 F



WIRE-MESH base prevents sagging on ends of deaerating heater. Inspection openings have replaceable aluminum reflective insulation

BOILER-WALL insulation is secured by wires anchored to steel studs. Double layer of mineral wool gets metal lagging as cover

1 Insulation thicknesses for equipment

Equipment	Temperature, F Shell	Temperature, F Waterbox	Specification schedule Shell	Specification schedule Waterbox
Feedwater heater No. 5	700	350	F	D
Feedwater heater No. 6	900	400	H	D
Feedwater heater No. 7	700	500	F	E
Feedwater heater No. 8	900	600	H	F
Deaerating heater No. 4	350		D	
Feedwater heater No. 2	250		C	
Feedwater heater No. 3	300		C	
Bearing water cooler	Cold water		Antisweat (A)	
Anion-exch units	Cold water		Cold-weather ins	
Cation-exch units	Cold water		Cold-weather ins	
Vacuum deaerator	Cold water		Cold-weather ins	
Activated carbon filters	Cold water		Cold-weather ins	
Caustic-storage tank	100		C	
Acid-storage tank	Cold water		Cold-weather ins	
Booster pumps	Cold water		Cold-weather ins	
Hot-water tank	180		C	
City-water-transfer tank	Cold water		Antisweat (A)	
Cooling-system surge tank	200		C	
Blowdown tank	250		C	
Vacuum tank, outdoor	Cold water		Cold-weather ins	
City-water-storage tank	Cold water		Cold-weather ins	
Circ-water reg valves	Cold water		Antisweat (A)	
Vacuum pump	Air		Cold-weather ins	
Condensate coolers	Cold water		Antisweat (A)	
Priming pumps	Cold water		Cold-weather ins	
Plant vacuum pumps	Air		Antisweat (A)	
Condensate coil tank	250		C	
Steam-jet air pumps	900		H	
Condensers (waterboxes)	Cold water		Antisweat (A)	
L-p-service water pumps	Cold water		Antisweat (A)	
Screen-wash pumps	Cold water		Cold-weather ins	
H-p-service water pumps	Cold water		Antisweat (A)	
Slag monkey pumps	200		C	
City-water booster pumps	Cold water		Cold-weather ins	
Lube-water pumps	Cold water		Cold-weather ins	
Priming ejectors	900		H	
Air-heater water-coil pumps	350		D	

was selected as the dividing point between medium- and high-temperature operation. To reduce installation costs, sections having a normal surface-operating temperature below 550 F got single-layer insulation. This insulation is molded to fit various pipe diameters and is available in standard lengths. For piping in the high-temperature range, a second sectional or segmented layer of insulation was added to the first, with joints staggered. A special high-temperature insulating cement fills the joints of the inner layer since it comes into direct contact with pipe surface. First-quality long-fibered asbestos cement points up the joints in the outer layer. Insulation on piping and equipment with operating temperatures up to 400 F is covered with 8-oz canvas. Above this, 22-oz asbestos cloth was used. Both jacketing materials are cemented to the insulation and provide a smooth wrinkle-free surface.

Construction reduces maintenance. Removing a section of flanged piping usually means a subsequent insulation repair. On this project, however, insulation repairs have been reduced to a minimum by using replaceable sections. These sections are fabricated of reflective sheet aluminum; they cover all flanged piping most frequently needing inspection or posing a potential need for repairs. Although aluminum sheeting costs more than conventional materials, its use is justified by lower maintenance costs. Insulation joints adjacent to flanges are mitered to give easy access to the fastenings and permit removal of an insulation section without damage.

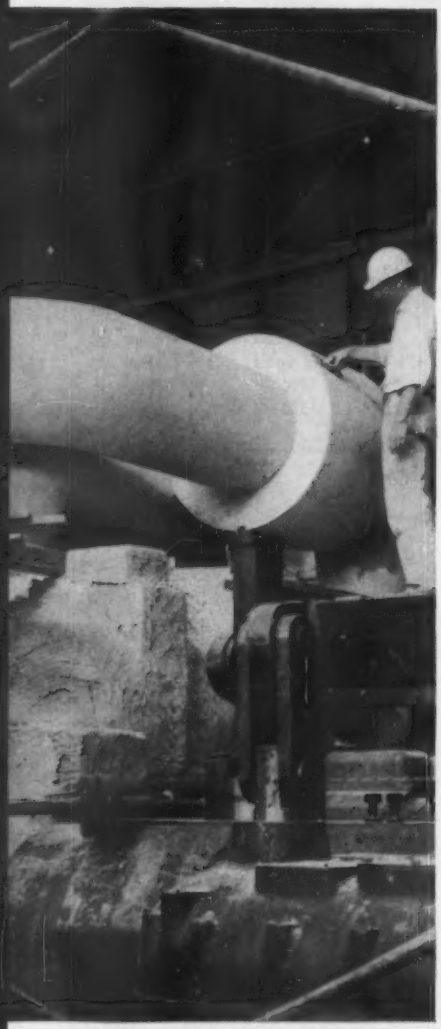
Expansion joints were installed in all insulation on piping having operating temperatures above 400 F. Located (for convenience) between pipe supports, these joints protect against heat loss due to possible

11 Insulation thicknesses for piping, in.

Ins materials	A	B	C	D	E	F		G		H		J		K	
Temp range, F	35-85*	86-150**	151-300	301-400	401-550	551-700		701-800		801-900		901-1000		1001-1100	
										layer					
						first	outer	first	outer	first	outer	first	outer	first	outer
Pipe size, in. Under 2			⅞	1-½	2	2	0	2	0	2	0	2	0	2	0
2			1-1/32	1-½	2	1-¼	1-½	1-¼	1-½	1-¼	1-½	1-¼	1-½	2-1/16	1-½
2½			1-1/32	1-½	2	1-5/16	1-½	1-5/16	1-½	1-5/16	1-½	1-13/16	1-½	2-1/16	1-½
3			1-1/32	1-½	2	1-9/16	1-½	1-9/16	1-½	1-9/16	1-½	2-1/16	1-½	2-1/16	1-½
4			1-⅛	1-½	2	1-9/16	1-½	1-9/16	1-½	1-9/16	1-½	2-1/16	1-½	2-½	2
6			1-⅛	2	2-5/16	1-½	1-½	1-½	2	2	2	2-½	2	3	2
8			1-¼	2	2-½	1-½	1-½	1-½	2	2	2	2-½	2	3	2
10			1-¼	2	2-½	1-½	1-½	1-½	2	2	2	2-½	2	3	2
12 and over			1-½	2	3	1-½	2	1-½	2-½	2	2	2-½	2	3	2

* "A" hair, felt, wool felt or equal, waterproofed inside or outside & thoroughly sealed against air penetration. Applied 1-in. thick in two layers so joints may be staggered

** "A," "B" or "C" or not insulated as required. For protection of personnel use "C" where surface temperature of 100 to 150 F may be encountered



CEMENT COAT on turbine piping is readied for final asbestos-paper and cloth finish

rupture of lagging and jacketing caused by expansion and contraction stresses.

Single-layer expansion joints were set up by leaving a space between the ends of two adjacent sections of insulation. Loosely packed mineral-wool covered with aluminum sheeting fills this space. One end of the sheeting was secured to the insulation, the other end left free to move.

Dual-layer expansion joints were staggered and their construction was slightly different. The joint in the inner layer was packed with mineral-wool fiber and a second layer of insulation was applied over it loosely enough to permit slippage but tight enough to contain the mineral wool. Joint in the outer layer was filled with fiber and covered with aluminum as described above.

Each of the station's three 2.1 million-lb-per-hr capacity steam generators are so large (20 stories high occupying 1300 sq ft of floor space) that a railroad spur was extended into them to bring construction materials directly to point of use. Lightweight insulation in standard packages was hoisted to work areas without resorting to power equipment. Several layers of mineral wool were applied to these units. For good contact with boiler drums, the first layer was secured with fibrous adhesive, then bound with steel bands and wire lacing. A second layer, shaped to fit, was fastened over the first. Joints were staggered, tightly fitted and pointed with high-temperature insulating cement. Boiler-wall insulation was anchored to steel studs and the outer surface finished off with suitable metal sheathing.

Main piping to turbines, carrying steam at 2475 psig, 1053 F, got specially molded insulation because the OD conforms to no standard pipe size. Two layers of 3-in. covered with 2-in. calcium silicate with staggered and pointed joints were fitted. Completing the installation were segments wired into place and an asbestos cloth jacket.

Insulation cost, $640,000, is a small fraction of the plant's total cost. It's an investment that'll pay dividends for many years. For every additional 1% reduction in heat loss, there's a calculated saving of 24-million Btu per hr at full load. At current fuel prices and present station loading, savings for a 1% reduction could equal $84 per day per unit, proving insulation's importance.

Modern process and utility plants place heavy emphasis on compact steam-piping layouts. To meet this goal and keep out operating problems you must . . .

Calculate piping stress accurately

Several POWER readers have written in to us during the last year, describing various operating or maintenance problems of their piping systems. In many of these cases piping supports, expansion joints and loops gave trouble because of poor piping-system design or improper equipment application. We talked to several piping-system designers, expansion-joint and pipe-hanger manufacturers to find out what could cause these problems.

Detailed answers to many of our questions will be included in coming POWER articles. On this page we spotlight some of the major trouble areas and the general cures which you can use to improve system design.

Piping vibration and fatigue often tie back to design of the original piping system. Although special hangers and supports handle many vibration problems, better design and application of conventional supports may be the prime answer. We learned that overly rigid piping supports caused a major portion of vibration and fatigue problems. When pipe supports hold line motion below certain minimum levels, extremely high pipe stresses are superimposed on basic design stresses. With any sort of cycling operation, temperature variations or pressure pulsations, the highly stressed lines will fatigue at points often far from the offending support.

Overly rigid supports affect system's critical vibration and natural period. By raising critical frequency, rigid supports have created conditions where steam-line harmonics match natural pulsations created in the flowing steam. This condition caused one 80-ft section of line to swing up to 2-ft sideways for hours at a time. Replacing three hangers with lighter, more-flexible units damped out vibration.

What caused this problem? Apparently improper use of design safety factors did the trick. In an effort to insure safe operation the designer had pyramided safety factors. This is a totally unnecessary and dangerous trick to pull in applying any hanger. Manufacturer's force-deflection data consists of a carefully balanced combination of design stresses and deflection ranges. You tamper with this careful balance when you impose added safety factors or create extremely high loadings by placing hangers or supports too far apart.

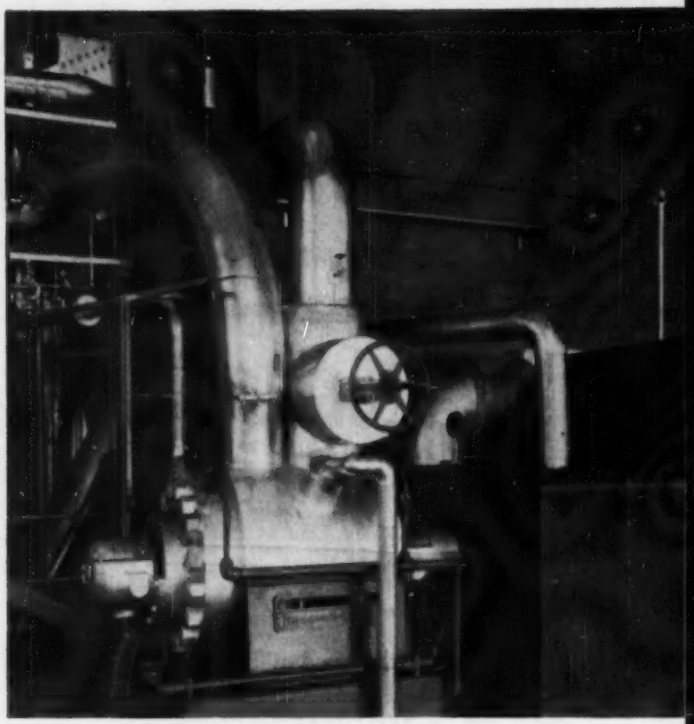
Expansion joints occasionally suffer fatigue failure. In digging into material for a coming article on corrugated-joint force-deflection relationships we found the same problem of overly rigid supports to be a contributing force in joint failure. Again safety factors played an important part in the problem. Force-deflection ratios for expansion joints of the nonslip type are based on assumptions of pure elastic deformation of joint material. This may not be entirely true for large deflections. As a result, published force-deflection data do include extra safety factors at large deflections because of the assumed elastic deformation. If any additional safety factor is piled on top in the misconceived notion that this prevents fatigue, loadings for hangers and supports are automatically too high. The resulting rigid support in turn affects performance of the expansion joint by creating greater-than-expected deflections. For more on this subject, see POWER's coming article on force-deflection ratio calculations for corrugated expansion joints—a description of basic theory.

Slip type expansion joints handle certain specialized cases of linear in-line expansion. Here the basic problem is one of limiting deflection to in-line axial movement. As in the corrugated expansion joint, support design actually determines expansion-joint performance. If supports at a distance from the slip joint are too rigid, excessive stress occurs at the joint and its supports. In each case the culprit is frequently some distance from the actual piping-system failure.

Overstressed piping need not reach the levels where failure is almost immediate or equipment is actually lifted off its foundations. The type of failure we are describing occurs at lower stress values and usually over an extended period. The insidious part of this problem is the tendency to blame the wrong element in the piping system for failure or poor performance.

Better design for your system, according to experts we questioned, depends on more careful calculation of piping stresses and deflections plus a better understanding of design factors included in manufacturer's data. Watch POWER for details of these factors.

Reliability and low maintenance are prime aims in high-pressure boiler-feed-pump sealing. Latest step in this direction—and a big one—is the . . .



SPEED, PRESSURE AND TEMPERATURE problems are often met by controlled-leakage seals in high-pressure boiler-feed pumps

Controlled-leakage seal . . .

One answer to high-pressure stuffing-box problems

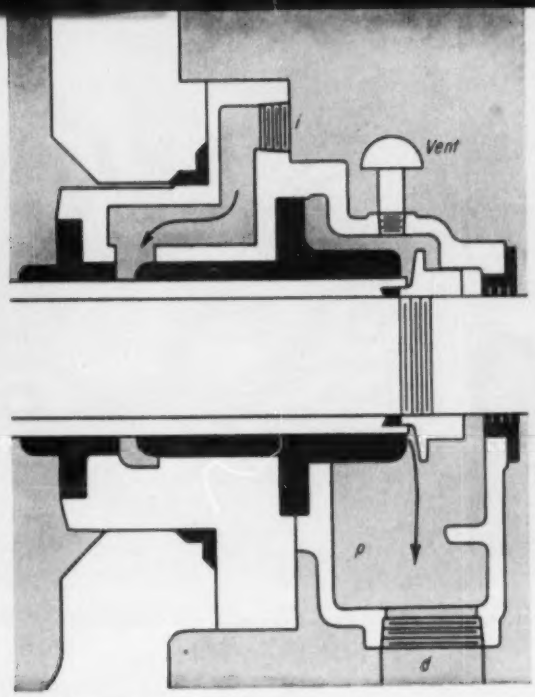
By T W EDWARDS, Assistant Editor

Controlled-leakage pump seals were developed about ten years ago to meet special problems in closed cycles of high-pressure boiler-feed-pump stuffing boxes and boiler-circulating pumps. In h-p feed pumps, pressures and temperatures vary widely with changing station loads, so life of normally packed stuffing boxes was far from satisfactory. Constant maintenance—gland adjustment and packing replacement—resulted. And, of course, in boiler-circulating pumps the temperatures and pressures normally encountered often preclude packing of any sort. Today, controlled-leakage seals have broadened their applications, also taking in high-speed boiler-feed pumps at 5000 to 9000 rpm where packing's rubbing speeds would be prohibitively high, and some open-cycle boiler-feed-pump applications.

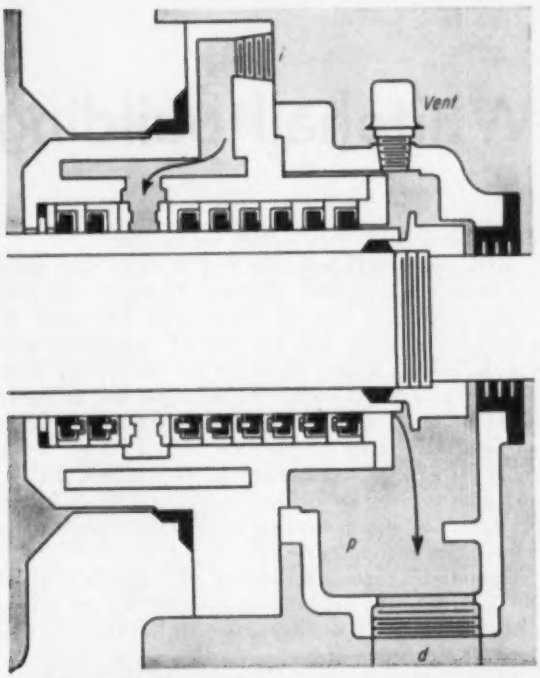
Solid bushing and floating ring are the two seal types. Both depend on close radial running clearances to limit flow severely. They inject cold condensate toward the inner end of the seal assembly, holding leakage temperature well below the flash point to prevent steaming.

Of course, injection-water continuity is a must. If leakage flashed, unequal erratic pressures could produce severe vibration and internal contact, destroying seal parts. Injection water must be perfectly clean. Close running clearances will not tolerate dirt. Strainers or filters must be used on all injection lines (*i*, drawings at right) close to each pump seal. Outboard leakage to atmospheric pressure must be carried away promptly (*d*) without letting hydraulic head build up in the plenum chamber (*p*) to cause leakage and spray along the pump shaft. Where booster pumps are used, controlled-leakage seals may have a multiplicity of injection and bleed-off points. Stepwise pressure-temperature reduction again eliminates flashing.

Materials are of prime importance in either design. Surface hardness must resist erosive effect of water and abrasion of occasional solids that sneak through in spite of the fine strainers. Since stainless steels are universal for controlled-leakage-seal parts very high hardness or differential hardening is necessary to prevent or at least



SOLID BUSHING was first development. Close running clearance limits flow while cold-water injection at seal limits temperature



FLOATING-RING SEAL lets individual rings adjust radially to shaft angularity and still hold radial leakage clearance closely

Controlled-leakage-seal design

Design conditions	Seal: Solid bushing	Seal: Floating ring
Injection pressure—about 20 psi above suction pressure at all loads		
Injection flow, gpm per box*	10 to 30	6 to 27
Outward leakage, gpm per box*	7 to 20	4 to 20
Inward leakage, gpm per box	3 to 10	2 to 7
Number of outboard rings	—	4 to 6
Number of inboard rings	—	1 to 2
Diametral clearance, in.	0.009 to 0.018	0.007 to 0.010

*Based on injection pressure of 200 to 250 psig

reduce galling during momentary shaft-sleeve contact.

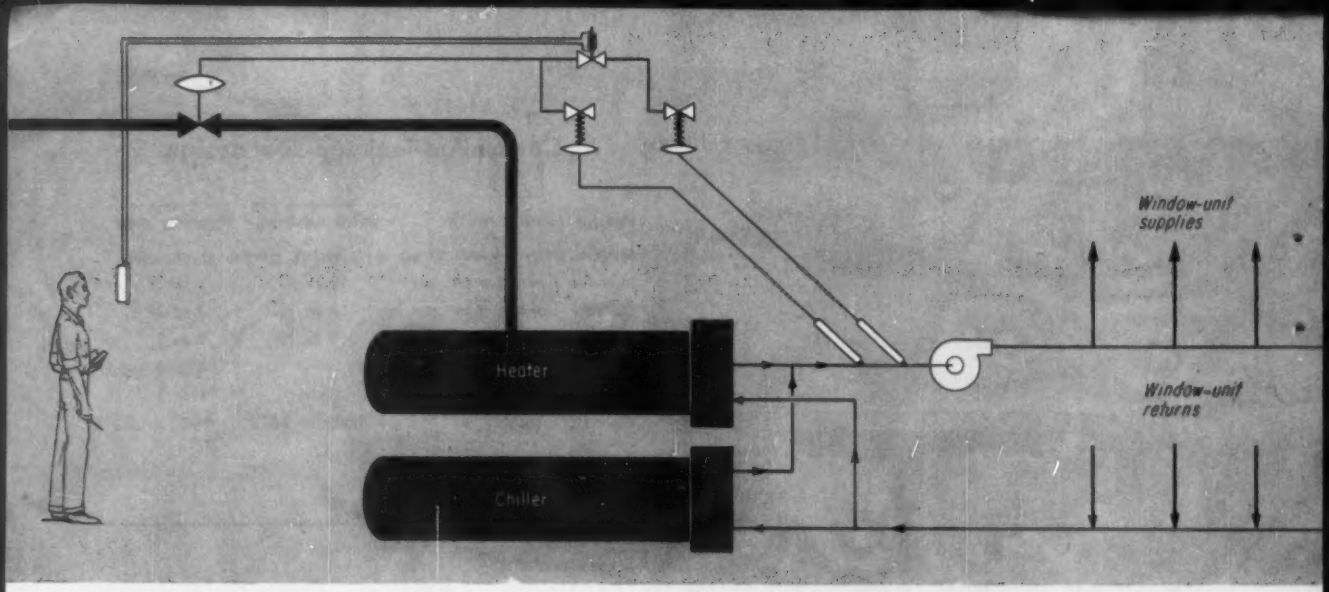
Table of operating conditions, above right, is general. Specific designs vary widely to meet special conditions. Case in point: some very large boiler-feed pumps are being built with necessarily large shaft diameters. Here running clearances must be greater than shown and flows correspondingly higher. But in general: floating-ring seals have smaller running clearances than solid bushings for same conditions, so flows are less.

Solid-bushing seals, top drawing, are rigidly fixed to pump casing with shaft sleeves running internally. Cold water at a pressure slightly higher than adjacent internal pump pressure is injected into the seal. Injection point: where rate of pressure breakdown (psi per in. of length) will be about the same for both inner and outer portions of the bushing. Cold water then flows in both directions, into the pump proper and to the plenum chamber. Inward flow effectively contains hot pumpage within the pump, and leakage to the plenum chamber drains away at atmospheric pressure and ultimately returns to the condenser through a trap or drain system.

Floating-ring seals, bottom drawing, substitute a nest of radially unsupported rings for the solid bushing. Mechanical setup of internal clearances is nowhere near as critical. Individual rings can adjust themselves radially to allow for slight shaft eccentricity and angularity, so closer running clearances are permissible, reduced flows result. A cage around rings sets limits to radial movement, and pins prevent rotation. Small springs hold each ring against the downstream side of the cage when the pump is idle; when it's running, hydraulic pressure forces them downsteam to provide radial sealing.

Choice between controlled-leakage-seal types is not clear-cut. Injection-water saving of the floating-ring design is a reality, but operation with imperfectly cleaned injection water is controversial. Larger internal running clearances in solid-bushing seals may let larger particles through without damaging seal surfaces, though of course particle size reaches an end point. Solid-bushing seals are more difficult to set up mechanically, and their setup is more critical. Increased angularity produced by improper pump warmup affects solid-bushing seals more severely. Shaft construction is also a factor—the more rigid the shaft, the less angularity between seal and shaft sleeve. There is some evidence that even after they're damaged, floating-ring seals may permit continued pump operation and convenient shutdown for repairs.

Don't look for a panacea in controlled-leakage seals. Simple packed stuffing boxes are by no means old-fashioned when properly applied, and face type mechanical seals also have their application. Check all three to see which will best handle your particular job.



CONTROL SYSTEM for heating and cooling cycles teams pilot-operated steam valves on heat exchanger's inlet with thermostatic switches

Careful preplanning of every construction step, plus the imaginative design of control systems, showed operation, construction savings as...

Sheraton-Whitehall building

How do you air condition an office building without inconveniencing your tenants and without prohibitive costs? This problem of shoehorning air conditioning into existing buildings at minimum cost is not unique. But, our solution was different, and may help you in future plans for modernizing building services.

Our problem was one of air conditioning and generally modernizing services in the 32-story Sheraton-Whitehall building in downtown Manhattan. This project was to be completed without a major upheaval for our tenants and still represent a thoroughly integrated, modernized office building. Too often, the attempt to meet the first requirement forces installations which appear almost temporary in nature.

Our solution entailed a two-fold operation. First, we had to inject a lot of imagination into the project to obtain the most economical overall cost. As a second point we had to thoroughly preplan every move to get the most out of what would be premium labor time.

Air conditioning system design offered an opportunity for some real savings. We decided on fan coil units supplied by circulated water. Heating-cooling loads would be handled by a shell and tube heat exchanger and a conventional water chiller. Building heat was already supplied by outside steam service, but three 15,000 lb per hr boilers lay idle in the basement. By modernizing firing equipment, the three units were put in condition to carry the heat load. New, high efficiency burning equipment, plus boilers already paid for, produced steam at less than outside service cost.

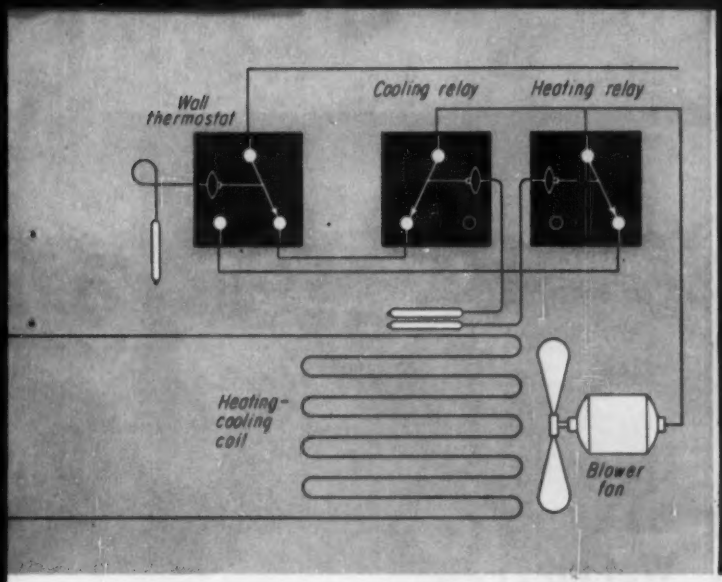
Reduced heating-cooling load at night could mean big savings in a building this size. To begin with, each of the 2000 room unit fan motors draw 100 watts. So chiller refrigeration cycle was shut off each night. During the heating season, we could save on fuel by dropping temperature at night. We arranged this as shown above by installing two temperature control pilot valves on each main steam temperature control valve. A solenoid valve in the line between pilots permitted the second pilot to override the base signal and increase temperature. The system operator reduced recirculated water temperature by tripping the solenoid.

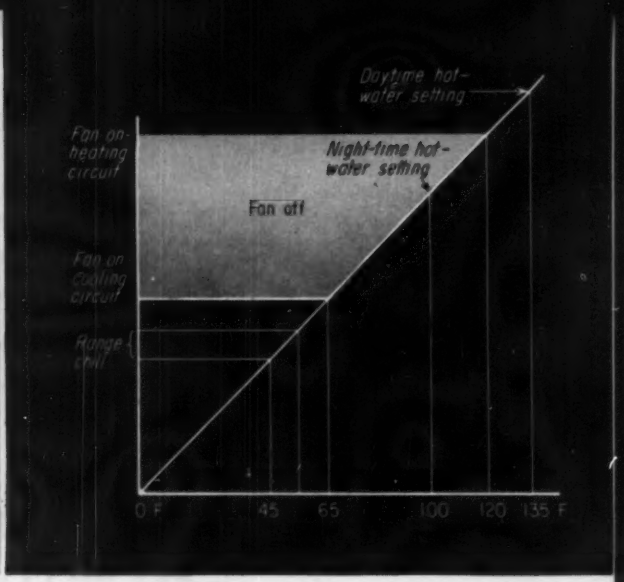
Complicated controls for cutting room unit fans in and out could have run project costs skyhigh. We got around this cost hurdle by combining simple, economical, temperature-actuated switches as shown above, right.

Conventional room thermostats are wired to make on rising or lowering temperature. In turn, switches actuated by supply water temperature close fan circuit only when water temperature is above 115 F or below 55 F. Chart, above right, shows sequence of operation.

By use of this simple control rig we were able to block operation of fans when we dropped steam temperature or shut off refrigeration cycle. For the several offices which operated at night, heating thermostats were set to close at 100 F, keeping these fans in operation.

Electrical load for the building had to be increased to handle central air conditioning units. Our solution





at each individual room unit. Switches operate in series to permit fan service only when temperature is above or below middle range

By STEPHEN HALL, Field Engineer, The Sheraton Corp of America

trims the cost of air conditioning

was to step up to 440 v as it came into the building, and feed new equipment, including condenser pumps and power fans on the 20th-floor roof. By running at the higher voltage we were able to use smaller size cables. In turn the smaller cables permitted a larger number of lines to be run through the existing conduits. Conversion of the electrical system has been a gradual program to prevent inconvenience to tenants at any time. Savings in material, power, labor covered cost of transformers.

Construction costs for air conditioning an occupied building usually run high. Work must be done on a piecemeal basis during office hours, or in concentrated doses at premium labor rates on weekends. Again, with the comfort of tenants as our prime concern we elected to do all work on weekends. This meant we would have to make every man-hour count if we were to keep our construction costs down.

Thorough preplanning of every stage of construction, plus some special construction methods, resulted in major savings. First, we surveyed each floor, and accurately plotted location of air conditioning units. Then we prepared as much of the equipment as possible during the week. Main risers and returns for water were installed. Individual units were to be supplied from feeders which would run around building perimeter at ceiling height. To speed installation, feeders were assembled with tees placed as needed, installed in prefabricated sections.

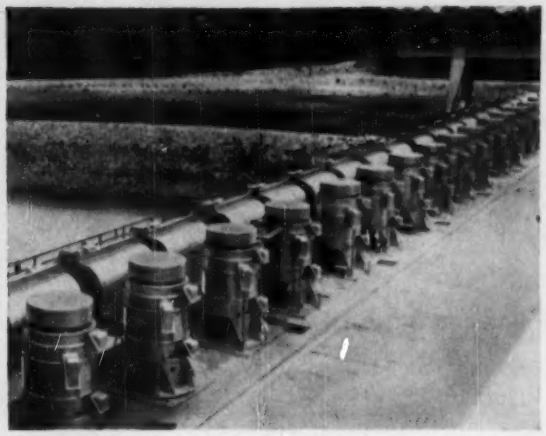
Each weekend, construction crews moved to selected offices, cut through the floor at premarked points and tied into the prefabricated feeders. Piping, etc at ceiling height was concealed behind suspended soffit boards which are readily removed for future maintenance.

Through this preplanned installation we were able to install an average of 125 tons of air conditioning per weekend. Although this was overtime work, our total installed cost ran less than estimates based on straight time labor only.

Overall savings for our installation were mighty impressive. Our construction costs were kept to an absolute minimum. During the 14 month period 96% of the office space was occupied. Operating and power costs for the completed installation ran 50% less than the same system without water temperature control and fan shut off at night. This has amounted to about $10,000 per month during heating season and $500 per month during cooling season. This is added to savings in first cost plus extended fan motor life for room units. Final savings were in the controls. We estimated comparable instrument controls for 2000 units plus steam temperature would have cost at least 500% more than the actual cost of our regulators, pilots and thermostat units.

System components

Steam regulators and pilots	Spence Engineering Co, Inc
Thermostat-controls	Ranco Inc
Heat exchangers	The Patterson-Kelly Co, Inc
Centrifugal chillers	The Trane Company



Dry pit . . . Wet pit . . .

Which vertical condenser circulator is best for you?

Choice between wet-pit and dry-pit vertical condenser circulators is not clear-cut. They both work well. Evaluation of tangibles does not even tell the whole story; so be sure to account for all intangibles when deciding which type is best

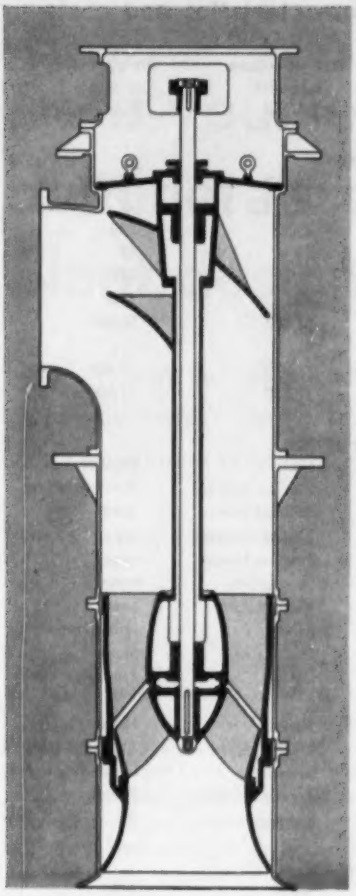
By C J TULLO and I J KARASSIK, Worthington Corp

For some years the trend in condenser circulators has been toward vertical pumps. Years ago, horizontal pumps were very popular, but high cost of large pit that was required (or priming equipment if pumps were set above low-water level) has eliminated them except in unusual cases. But there are still two basic types of vertical condenser circulators—*wet pit* and *dry pit*—and the choice between them for a particular central-station installation depends largely on an evaluation of tangible costs together with many intangibles which must be based on experience and good judgment. Here's where you come in. Since the choice cannot be absolute (you can't say that one type won't work), the best type for you will be revealed only by a careful and exhaustive study of all factors bearing on your particular installation.

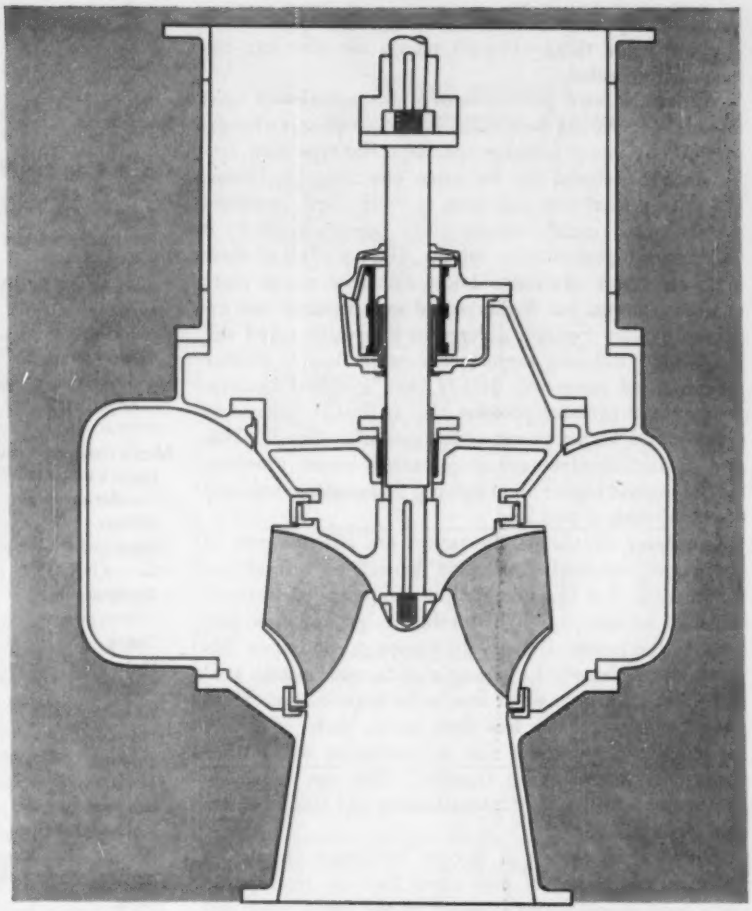
But before we get into these factors and how they affect condenser circulator type selection, let's define just what we mean by *wet pit* and *dry pit* pumps.

Dry-pit condenser circulators operate surrounded by air. They usually have volute casings and external oil-lubricated bearings. Mixed-flow impeller is designed for an intermediate specific speed and is normally fully closed. Bottom suction connection may be grouted into the concrete structure which also serves as water inlet tunnel; side-discharge connection is conveniently located to meet most station layouts. Center line of pump is set below low water to insure adequate prime at all times. Depending on setting (elevation difference between pump and motor) either a long shaft, perhaps with several intermediate bearings, or a close-coupled arrangement is used. In latter case, motor base is frequently supported directly on the pump casing.

Wet-pit condenser circulators are either partially or fully submerged in the water. They are diffuser pumps with semi-open or closed impellers. Suction bell and impeller are set well below low water since npsh and rotative speeds are usually higher than they are for comparable dry-pit types because of higher pump specific speed. Discharge elbow at a convenient elevation has guide vanes to minimize internal losses. A tube encloses line bearings designed for water lubrication, usually by an external source since circulating water may not be satisfactory. (Oil lubrication is almost always out of the question since there is a chance that oil might leak into the circulating water, coat condenser tubes and drastically reduce condenser heat-transfer ability).



"PULL-OUT" feature in vertical wet-pit condenser circulator eases pump inspection



CLOSE-COUPLED DRY-PIT CONDENSER CIRCULATOR has fully-closed mixed-flow impeller. External bearing is oil lubricated—thrust is carried by upper motor bearing

To facilitate maintenance, wet-pit condenser circulators are usually designed so that pump internals can be removed without having to lift the heavy column pipe or disconnect pump-discharge connection. With this "pull-out" design, suction bell, impeller, diffuser, shaft, shaft-cover tube and discharge guide vanes can be lifted out vertically, leaving the remaining pump parts in place.

Mechanical considerations play an important part in choice between wet- and dry-pit condenser circulators. Bearing design, operation and maintenance of both types must be examined to insure your getting the pump you want. In the dry-pit type where oil lubrication is possible, design and operation can approach optimum conditions. There need be no compromises here. But in wet-pit types, need for water lubrication complicates bearing design, materials and can shorten bearing life—all adding to possible maintenance costs. This is a necessary design compromise which must be recognized and weighed against the benefits of a wet-pit design.

Materials used in wet- and dry-pit condenser circulators will vary considerably depending on the quality of the water pumped and the type of pump involved. But, as a general rule, dry-pit pumps require fewer changes to meet changing water conditions because only the impeller and rings are primarily affected. On the other hand, *all* submerged parts of a wet-pit pump must be carefully reviewed, particularly where sea water is to be pumped. In addition to changing materials of the impeller and rings, danger of electrolytic action may require changes in shaft, diffuser, column pipe, shaft-enclosing tube and other small parts. Bear in mind that the higher specific speeds of wet-pit condenser circulators mean higher rotative speeds—and higher internal velocity. So the effect of increased erosion due to these higher internal velocities must be considered in selecting pump construction materials.

Maintenance costs anticipated for disassembly and inspection must be accounted for. Dry-pit designs involve much less weight to lift and provide increased convenience since bearings and internal parts can be frequently inspected without complete pump disassembly. In a wet-pit pump—even of the pull-out type—most parts

must be completely removed from the column pipe before you can see a thing. Dry-pit pumps are also less frequently dismantled.

Hydraulic and performance characteristics must be checked. As has been said, wet-pit condenser circulators usually are of a higher specific speed type than dry-pit pumps designed for the same operating conditions. But exactly what does this mean to you? First, increased specific speed usually means lower pump efficiency; it also means higher rotative speeds. The net effect of these is to an extent offsetting—lower efficiency means more auxiliary power, but higher speed may mean a less expensive motor. Second, differences in specific speed will give widely differing performance-curve shapes. Higher specific-speed pump will usually have a steeper head-capacity curve (greater pressure rise as flow is reduced to zero) and a higher power consumption at shutoff. This is a distinct disadvantage since current-inrush problems may arise, and higher hp at reduced flows means increased operating costs at part load.

Condenser circulators themselves are but one part of the system—successful operation depends on several outside factors. For example, wet-pit pumps are particularly sensitive to suction-well hydraulic design and flow patterns to the pump. But dry-pit pumps do not share this sensitivity because inlet piping and formed suction passages insure uniform water flow to the impeller eye. Since wet-pit pumps require less floor space, there is always the temptation to reduce size of installation still further by placing pumps closer together. This can aggravate an already sensitive hydraulic situation and lead to costly field changes.

Drivers for wet- and dry-pit condenser circulators differ only slightly. In both cases they are required to carry dead-weight thrust imposed by the pump rotor and in some designs must carry all or part of the hydraulic thrust developed in the pump. So in either case, a high-thrust motor is usually needed. Speed and power are the two main variables in motor selection between wet- and dry-pit pumps.

First cost and operating cost are two factors that can be directly evaluated. In general, a dry-pit type will be less expensive, and table, right, shows typical comparison for use in average brackish bay water. For more severe operating conditions in highly polluted or aerated sea water, cost of the dry-pit pump would increase only about 20% while the wet-pit pump would cost a whopping 50% more. But for clean fresh water where standard construction materials would be suitable, this first-cost difference between wet- and dry-pit condenser circulators is minimized and both would be about equal at about 72%, see table, right. This assumes a relatively short pump setting, about 20 ft. But for longer settings, pump costs again start to diverge. In a dry-pit pump, added length means only added shaft and perhaps a few more bearings; so cost doesn't increase greatly. But in a wet-pit pump more length means more column pipe and shaft-cover pipe in addition to added shaft and bearings. Bear in mind that for very short settings, the minimum possible length of a large-capacity wet-pit pump may be as high as 20 ft.

Installation costs will vary widely between locations and depend on standard practices of the owner. In general, however, pit costs for a dry-pit condenser circulator increase more rapidly with increased pit depth because of large concrete mass required to prevent floating of the dry-pit structure itself.

So equipment and installation costs vary inversely with pit depth, and the designer must optimize them to get the best and least-costly total job.

Pump location within a station depending on pump type can affect crane costs. Unless crane facilities of adequate capacity are already required for other purposes over condenser circulator location, the heavier wet-pit design will require a larger crane for disassembly than will a dry-pit type.

So a detailed evaluation for wet- vs dry-pit condenser circulators must be made for each and every job. No two are the same. And be sure to include your very best judgment and experience when assigning dollars to the intangibles. In the long run, they can far outweigh the more easily evaluated tangibles such as first cost and direct operating cost.

Compare characteristics and costs

Specification	Wet-pit column type with diffuser	Dry-pit mixed-flow type with volute casing
Operating conditions		
Capacity, gpm	78,000	78,000
Total head, ft	22	22
Full-load speed, rpm	290	220
Efficiency, %	84	88
Brake hp (1.0 Sp Gr)	515	492
Motor hp	600	500
Pump wt, lb	60,000	50,000
Vertical thrust, lb		
At design conditions	17,000	10,000
At zero flow	37,000	12,000
Materials of construction		
Motor base		Steel or c.i.
Impeller and rings	Zincless bronze	Zincless bronze
Diffuser	Zincless bronze	none
Pump barrel	Zincless bronze	none
Suction bell	Zincless bronze	none
Discharge elbow	Ni-cast iron	none
Column pipe	Ni-cast iron	none
Casing	none	Ni-cast iron
Shaft	Mn bronze	Steel
Shaft sleeve	Monel	Bronze or monel
Submerged bolts, nuts and screws	Monel	Monel
Coupling	Rigid, flanged	Rigid, flanged
Thrust bearing	In motor	In motor
Line bearings	Bronze or rubber	Babbitt
Bearing lubrication	Fresh water	Oil
Approximate prices		
Pump	100%	72%
Motor	100%	120%
Total	100%	86%

Do-it-yourself demineralizer-plant design

Here's a way to rough out demineralizer plant you need. Start with a good water analysis, effluent quality you want

By W C BURNS, Project Manager, Cochrane Corporation

Demineralizer plant arrangements are legion—detailed studies of each alternate to show best system for your plant can be costly and time consuming. But for preliminary purposes approximate solutions will weed out arrangements not suited to your particular needs, show relative desirability and approximate operating costs. You will also get some idea of physical size of major equipment needed to give desired effluent quality.

To start out you need a good water analysis and accurate predictions of required plant effluent quantity and quality. (Don't forget to include margin in design flow selected to cover future conditions and plant emergencies.) It often proves desirable to set up both design and maximum flows. Then you know where margin starts to hurt by requiring larger equipment and higher first cost. Perhaps under emergency conditions you can make do with lower quality and save money.

Let's run through an example of a preliminary design using the water analysis, above. (If your water analysis is not expressed in these terms, see POWER *Special Report*, Dec 1958, pp 80 and 81 for conversion procedures.)

Design parameters for our example are: (1) Daily use of demineralized water is to be 216,000 gal. Large treated-water-storage tank will take care of 4-hr down period during regeneration. So single-cation and single-anion units will suffice. Average flow during the daily 20-hr running period will be 180 gpm (four hr per day reserved for regeneration). If no treated-water-storage tank is available, you should consider a double-unit demineralizer—two anion and two cation units—to give uninterrupted flow during regeneration.

(2) Treated water is to contain no more than 2-ppm dissolved solids (as $CaCO_3$) and not more than 0.05-ppm dissolved silica (as SiO_2).

(3) Demineralizer plant will be provided with clean influent water, free from turbidity. (If in your case, this is not true, see POWER *Special Report*, March 1959, for acceptable pretreatment methods.)

Water analysis for preliminary design

Impurities	ppm
Calcium (Ca) as $CaCO_3$	75
Magnesium (Mg) as $CaCO_3$	25
Sodium (Na) as $CaCO_3$	100
Total cations as $CaCO_3$	200
Bicarbonate (HCO_3) as $CaCO_3$	125
Carbonate (CO_3) as $CaCO_3$	0
Sulfate (SO_4) as $CaCO_3$	40
Chloride (Cl) as $CaCO_3$	35
Total anions as $CaCO_3$	200
Total hardness as $CaCO_3$	100
M O alkalinity as $CaCO_3$	125
Iron as Fe	0.1
Turbidity	2
Carbon dioxide (CO_2) as $CaCO_3$	9.1
Silica (SiO_2) as $CaCO_3$	10
pH was found to be 7.4	

Preliminary design should start with cation unit. From our typical water analysis we get:

Total cations = 200/17.1 = 11.7 grains per gal (gpg)

Percent sodium (Na) = 100/200 = 50%

Percent alkalinity ($HCO_3 + CO_3$) = 125/200 = 63%

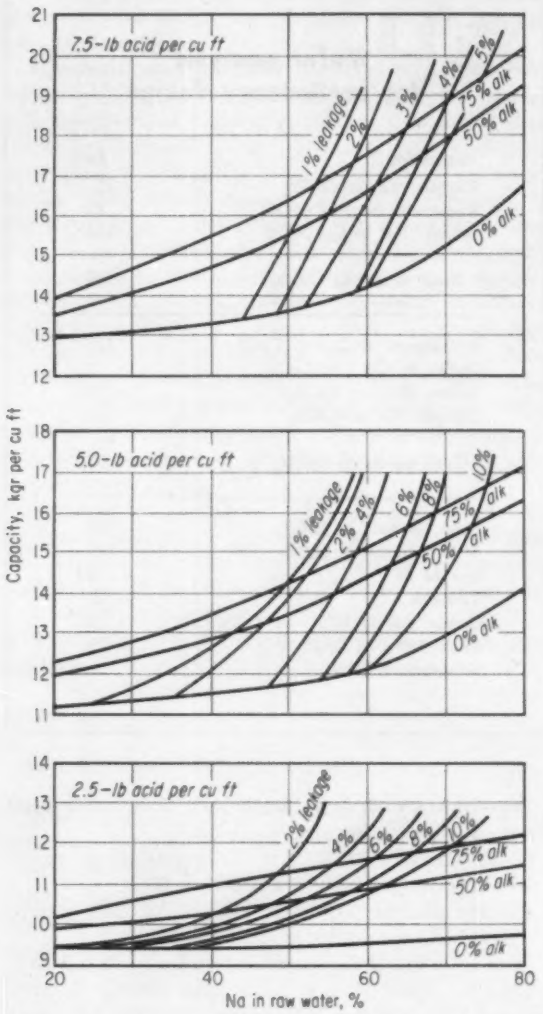
Percent leakage desired = 2/200 = 1%

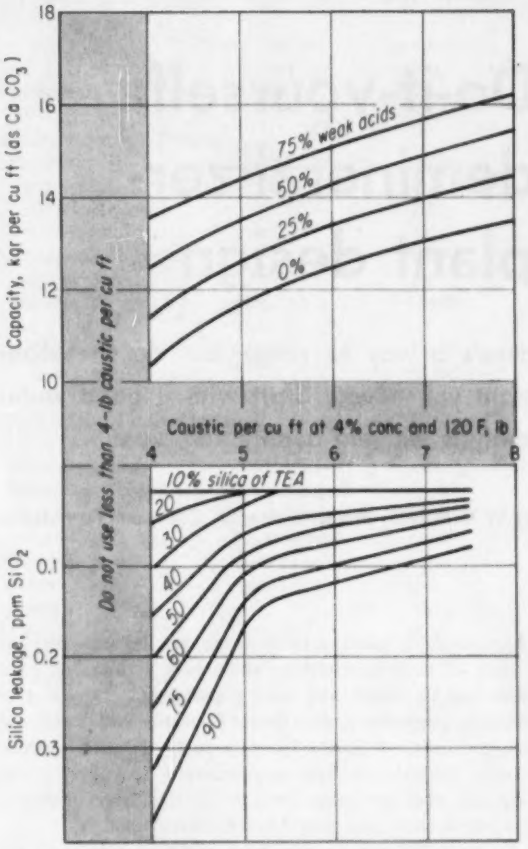
Now go to Fig. 2. Curves are shown for 0, 50 and 75% alkalinity. Since 63% is better than halfway between 50 and 75%, use the 75% curve. At 50% Na, curve shows that 2.5-lb acid per cu ft resin give 3% leakage and that 5-lb acid give the desired 1% leakage. So the cation rating is found to be 14.2 kg per cu ft when using 5-lb acid (100% sulfuric, H_2SO_4) per cu ft resin.

Now go to the nomograph to find the amount of cation resin needed. Connect *plant flow* (180 gpm) to *operating time* (20 hr) and determine pivot *A*. Then connect *total cations* (11.7 gpg) to pivot *A* and determine pivot *B*. Finally connect pivot *B* to cation rating (14.2 kg per cu ft). Extend line and read cu ft of resin needed. Answer: 175 cu ft. To take care of the additional cation-treated water needed to regenerate the anion unit, add 10% giving a total of 192.5 cu ft cation resin needed.

To find vessel size, go to table on p 77. For single units with 180-gpm flow, recommended vessel size is 6½-ft dia. Bed depth is then 5.8 ft (192.5 cu ft/33.2 sq ft = 5.8 ft). Add a minimum of 75% freeboard for backwashing. So if a flat-bottom vessel is used, you get a straight-shell height of 10 ft, 2 in. Note that recommended bed-depth range is 2½ to 8 ft. If your depth falls outside these limits, change vessel dia or increase the amount of resin.

Next, let's continue our preliminary design with the anion unit. From our water analysis:





1 Anion-resin ratings vary with silica leakage permitted and percent weak acids. Don't use less than 4-lb caustic per cu ft

2 Cation-resin ratings for various levels of acid regeneration and alkalinities show resin-exchange capacities and leakages

Bicarbonate (HCO_3)	=	125 ppm as $CaCO_3$
Sulfate (SO_4)	=	40 ppm as $CaCO_3$
Chloride (Cl)	=	35 ppm as $CaCO_3$
Silicate (SiO_2)	=	10 ppm as $CaCO_3$
Carbon Dioxide (CO_2)	=	9.1 ppm as $CaCO_3$
Total		219.1 ppm as $CaCO_3$

TEA = 219.1/17.1 = 12.8 gpg
% SiO_2 = 10/219.1 = 4.6
% Cl = 35/219.1 = 16
% weak acids = (125 + 10 + 9.1)/219.1 = 66

From Fig. 1, with a silica content of 10% or less, 4-lb caustic per cu ft anion is enough to give an effluent silica of less than the 0.05 ppm required. Resin capacity is shown as 13.2 kg per cu ft. Note that caustic quantities of less than four lb per cu ft are never used because lesser values could produce distribution problems and channeling. With our simple 2-bed demineralizer, guaranteed limit of silica leakage is never less than 0.02 ppm.

Resin rating must be adjusted for Cl in influent.

If over 15% multiply resin capacity by 0.95

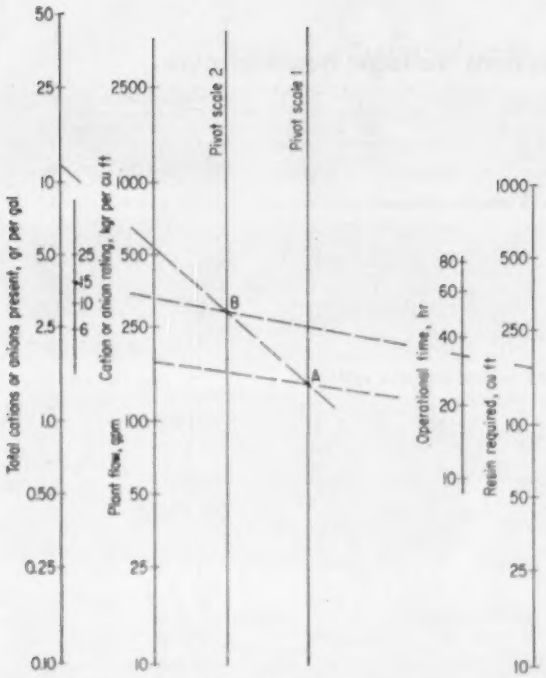
If over 40% multiply resin capacity by 0.85

Since our chloride content was over 15% but less than 40%, resin capacity should be corrected to 95% of the 13.2 kg per cu ft found (or 12.5 kg per cu ft).

Use the nomograph again to find anion-resin requirements. The answer: 220 cu ft. Did you get it? But now no compensation factor is needed as was the case with the cation resin. So the 220 cu ft found in the nomograph stands.

Table again shows vessel recommended to be 6½-ft dia since throughput is the same. Bed depth is 6.7 ft (220 cu ft/33.2 sq ft = 6.7 ft). For lighter anion resins, 100% freeboard is needed to prevent loss during backwash. So vessel height is 13 ft, 5 in. Again, bed depth should fall in the 2½- to 8-ft range. If it doesn't, change vessel dia or resin quantity.

Decarbonator will lighten anion-unit load. Let's see what the effect would be were we to install a decarbonator between the cation and anion units. Since it would remove much of the CO_2 in the anion-unit influent, both amount of resin and chemical necessary to regenerate will be reduced. Actual reduction of CO_2 will be to about 5 ppm (or 5.5 ppm as $CaCO_3$).



3 Resin requirements for either cation or anion demineralizer sections are based on total ions present, resin ratings and flows

Vessel size based on optimum bed loading

Vessel dia, ft	Bed area, sq ft	Recommended flows per unit, gpm	
		Single unit	Double unit
2½	4.9	30	40
3	7.0	42	57
3½	9.6	58	77
4	12.6	75	100
4½	15.9	95	127
5	19.6	118	157
5½	23.8	143	190
6	28.3	170	227
6½	33.2	200	265
7	38.5	231	308
7½	44.2	266	354
8	50.3	303	403
8½	56.7	341	455
9	63.6	381	508
9½	70.9	426	568
10	78.5	471	628
10½	86.5	512	683
11	95.0	570	760

Maximum values shown for double units are recommended for short periods only when one of two units is down for regeneration.

How to figure your chemical costs

In preliminary design of demineralizer plants, early determination of probable chemical costs can narrow down design alternates and help pinpoint best arrangement for your particular needs. Using the hypothetical design previously arrived at, let's look at probable chemical costs.

In the cation unit we found that we had a resin loading of 14.2 kg per cu ft when regenerating with 5-lb acid per cu ft resin. Assuming an acid cost of 1½¢ per lb we arrive at 6.8¢ per 1000 gal treated. This includes a 10% compensation factor to cover the cation-treated water used to regenerate the anion unit.

$$\frac{\text{5-lb acid per cu ft}}{\text{14.2 kg per cu ft}} \times \frac{\text{0.0117 kg}}{\text{gal}} \times 1.10 \text{ factor} \times 1.5¢ \text{ per lb acid} = 6.8¢ \text{ per M gal}$$

For the anion unit without a decarbonator we found that 4-lb caustic gave a resin capacity of 12.5 kg per cu ft. So chemical cost (assuming caustic at 3½¢ per lb) is:

$$\frac{\text{4-lb acid}}{\text{12.5 kg}} \times 12.8 \text{ gpg} \times 3.5¢ \text{ per lb} = 14.3¢ \text{ per M gal}$$

But with a decarbonator in the system, these anion regeneration costs become:

$$\frac{\text{4-lb acid}}{\text{10.6 kg}} \times 5.3 \text{ gpg} \times 3.5¢ \text{ per lb} = 7¢ \text{ per M gal}$$

So our total chemical cost without a decarbonator is 21¢ per M gal (or $16,600 per yr). Compare this to the total chemical cost with a decarbonator in the system. Here it would be 13.8¢ per M gal (or $10,850 per yr). The annual saving of $5750 may well be enough to cover total installed cost of the decarbonator. You must, however, check your own system to find out whether a decarbonator will pay off for you.

First we must refigure TEA on basis of reduced CO_2:

Bicarbonate (HCO_3)	=	0 ppm as $CaCO_3$
Sulfate (SO_4)	=	40 ppm as $CaCO_3$
Chloride (Cl)	=	35 ppm as $CaCO_3$
Silicate (SiO_2)	=	10 ppm as $CaCO_3$
Carbon dioxide (CO_2)	=	5.5 ppm as $CaCO_3$
Total	=	90.5 ppm as $CaCO_3$

TEA = 90.5/17.1 = 5.3 gpg
% SiO_2 = 10/90.5 = 11
% Cl = 35/90.5 = 39
% weak acids = (0 + 10 + 5.5)/90.5 = 17

From Fig. 1, resin rating is now 10.6 kg per cu ft with 4-lb caustic. Since anion-unit load is reduced, it too must be refigured. From Fig. 3 we find that only 108 cu ft resin are needed (vs 220 without decarbonator) and from the table, vessel height will be 6½ ft straight sides (vs 13 ft, 5 in. without decarbonator). First cost of anion resin and vessel is reduced when a decarbonator is used.

A secondary benefit of a decarbonator is the reduction in water necessary to rinse anion unit. So the cation-unit resin requirement can probably be reduced by about 5%. Remember that this light reduction might change cation-vessel size and save more first cost.

Table 1—Preferred system voltage nomenclature

Industrial and commercial power systems—nominal system voltage		Favorable-voltage zone		Tolerable-voltage zone		Electric utility power systems—nominal system voltage	
4-wire wye	3-wire wye or delta	minimum	maximum	minimum	maximum	4-wire wye	3-wire wye or delta
Voltages at main-substation primary — h-v 3-phase systems							
	23,000	See note		20,400	25,800		23,000
	27,600			24,500	31,000		27,600
	34,500			30,600	38,000		34,500
	46,000			40,000	48,300		46,000
	69,000			60,000	72,500		69,000
	115,000			100,000	121,000		115,000
	138,000			120,000	145,000		138,000
	161,000			140,000	169,000		161,000
	230,000			200,000	242,000		230,000
Voltages at secondary-substation primaries — m-v 3-phase systems							
	2400	2300	2600	2200	2750		2400
	4160	4000	4500	3810	4760	2400/4160Y	
	4800	4600	5200	4400	5500		4800
	6900	6600	7470	6320	7900		
		6900	7800	6600	8250		7200
		4600/8000Y	5200/9000Y	4400/7620Y	5500/9520Y	4800/8320Y	
		11,000	13,000	10,500	13,200		12,000
		6900/12,000Y	7800/13,500Y	6600/11,450Y	7920/13,700Y	7200/12,470Y	
		7270/12,600Y	8250/14,300Y	7000/12,100Y	8320/14,500Y	7620/13,200Y	13,200
		13,200	14,950	12,630	15,000		
	13,800	13,000	15,000	12,600	15,500		14,400
Voltages at utilization equipment—							
l-v 3-phase systems							
208Y/120	230	197Y/114	216Y/125	193Y/111	230Y/127	120/208Y	230
	210	240	200	230			
460Y/265	460	434Y/250	480Y/277	422Y/244	500Y/288	265/460Y	460
	575	430	480	400	500		575
		525	600	500	625		
m-v 3-phase systems							
	2400	2200	2450	2100	2540		2400
	4160	3810	4240	3630	4400		4160
	4800	4400	4900	4200	5080		4800
	6900	6320	7050	6040	7300		6900
	13,800	12,630	14,100	12,800	14,600		
l-v 1-phase systems							
3-wire	2-wire					3-wire	2-wire
120/240	120	110	125	107	127	120/240	120
		110/220	125/250	107/214	127/254	240/480	
		220/440	250/500	214/428	254/508		

Note: For systems with nominal voltages above 13,800 volts, the designation of a "Favorable Zone" has been omitted as being somewhat less necessary than for the lower voltages.

With no standard to follow, the selection of system and equipment voltages often is confusing. So AIEE just took the first step by recommending preferred . . .

Voltage nomenclature for industrial and commercial systems

A paper presented at last month's AIEE General Meeting was the culmination of efforts by a working group of the Industrial and Commercial Power Systems Committee to evaluate existing voltage nomenclature and recommend *preferred practice*. While it isn't the Committee's function to prepare and publish a standard, it is anticipated that the American Standards Association will revise its Standard ASA C84.1-1954 and will appropriately recognize the system voltage nomenclature preferred in industrial- and commercial-building electrical systems.

Preferred practice as recommended by the working group is shown in tables above, adapted from more detailed tables in the Transactions paper, 60-1182. (You can get paper from AIEE at 33 W 39th St, New York 18, N. Y.) Tables shown, even though in abridged form, give system and equipment nomenclature.

Need to review nomenclature is indicated by fact that the only nationally accepted standard for system voltage designations is the ASA standard mentioned (also known as EEI Pub No. 117, NEMA Pub No. 117) which is primarily directed toward the electric utility field. A por-

Table 2—Preferred voltage ratings for ac equipment

System	Preferred nominal system voltage	Generator rated voltage	Transformer secondary rated voltage	Transformer primary rated voltage	Switchgear nominal rated voltage	Capacitor rated voltage	Motor and control rated voltage	Ballast rated voltage
Single-phase (and 1-phase components on 3-phase)								
	120	120	120	120	120	...	115	120
	120/240	120/240	120/240	240	240	230	230	236
	208Y/120 (Three-phase)	125/216Y (Three-phase)	216Y/125 (Three-phase)	120	240	230	115	120[1]
	460Y/265 (Three-phase)	277/480Y (Three-phase)	480Y/277 (Three-phase)	480	480	460 or 480	...	277[1] or 265[1]
Three-phase								
L-v	208Y/120	125/216Y	216Y/125	216	240	230	208 or 220	208[2]
	230	139/240Y	240Y/139 or 240	240	240	230	220	236[2]
	460Y/265	277/480Y	480Y/277	480	480	460 or 480	440	460[2]
	460	277/480Y	480Y/277	480	480	460 or 480	440	460[2]
	575	346/600Y	600Y/346 or 600	600	600	575	550	...
M-v	2400	1388/2400Y	2400Y/1388 or 2400	2400	2400	2400	2300	...
	4160	2400/4160Y	4160Y/2400	4160	4160	4160	4000	...
	4800	2770/4800Y	4800Y/2770 or 4800	4800	13,800 or 7200	4800	4600	...
	6900	3980/6900Y	6900Y/3980	6900	7200	6640 or 7200	6600	...
	7200	3980/6900Y	7200Y/4160	7200	13,800 or 7200	7200	6600	...
	12,000	7210/12,500Y	12,000Y/6920	12,000	13,800	12,470	11,000	...
	7200/12,470Y	7210/12,500Y	12,470Y/7200	12,000	13,800	7200 or 12,470	...	...
	13,200	7970/13,800Y	13,200Y/7610	13,200	13,800	7620 or 13,200	13,200	...
	13,800	7970/13,800Y	13,800Y/7970	13,800	13,800	13,800 or 13,200	13,200	...
	14,400	8320/14,400Y	13,800Y/7970	13,800	14,400	14,400	13,200	...

[1]Line-to-neutral rating. [2]Line-to-line rating.

tion of this standard was modified for inclusion in the booklet, *Electric power distribution for industrial plants*, AIEE No. 952. But the system voltage designations had to be modified because the standard doesn't include all the presently accepted preferred industrial voltages. Example: the 13.8-kv system isn't listed and preference is given to the 7.2-kv utility system over the 6.9-kv industrial system.

As a result, the Committee felt there was need for further clarification in industrial and commercial systems of (1) preferred system voltages and (2) method of identifying the voltages.

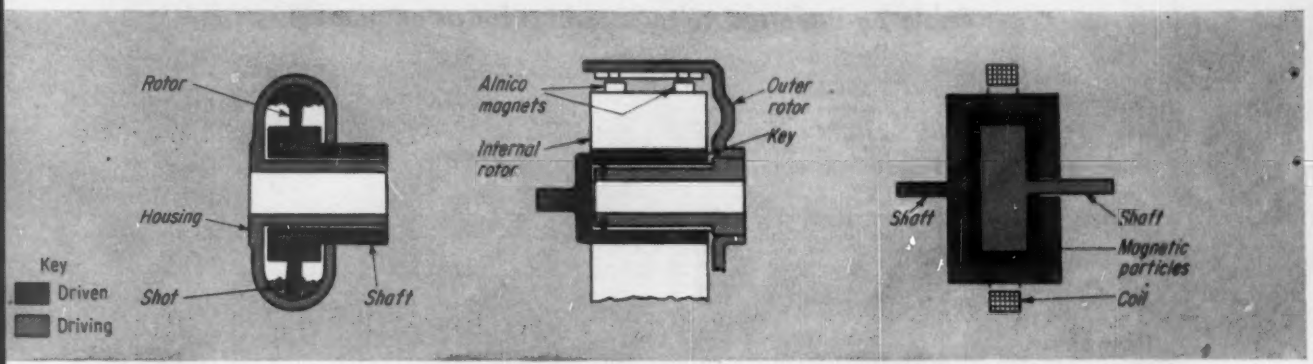
A comparison is made in Table 1 of the preferred nominal system voltages for industrial and commercial systems; utility power-systems practice is included. Table 1 uses the generally accepted minimum and maximum voltages for favorable and tolerable zones as given in the ASA standard. Widespread industrial practice uses 3-phase systems and for this reason the industrial-plant engineer identifies his system by the nomenclature on the supply transformer. Example: a system supplied by a transformer rated 13,800 volts is called a 13.8-kv system. It is urged that this practice be continued for medium-voltage systems.

For low-voltage systems it has also been the practice to identify the system nominal voltage by the rating on the transformer; thus a system served by a 480-volt transformer was a 480-volt system. With acceptance of more suitable low-voltage nomenclature, it is recommended that the system described now be identified as 460 volt.

With well-established minimum and maximum voltages of 420 to 480 volts for the previously designated 480-volt system, it's evident that the nominal system voltage was also the maximum voltage in the favorable zone. This is not a normal relationship at other voltage levels; therefore, a new preferred nominal system voltage of 460 volts is recommended. This point is discussed at length in the Transactions paper.

Distinction is made between 3-wire and 4-wire 3-phase systems by means of voltage nomenclature. Thus the 4-wire 460-volt system is designated 460Y/265 (previously 480Y/277 v) and the 3-wire system is 460 volts.

These basic designs provide wide range of torque control



DRY FLUID coupling transmits torque when steel shot is compacted by centrifugal force

PERMANENT-MAGNET eddy-current drive reacts to its induced and permanent fields

MAGNETIC-PARTICLE clutch controls bond between rotating members by varying field

Adopting one of these "soft" coupling devices lets you solve simply many problems of acceleration and load-shock by . . .

Cushioned starts for tough loads

Often a load will require starting and accelerating characteristics which can't be matched by standard NEMA-design squirrel-cage induction motors. One solution is to use a motor with speed-torque characteristics that can be controlled, such as dc motors or wound-rotor induction motors. It may be more practical in many cases to interpose a torque-converting device between drive motor and load. Several basic devices (six are shown above) are available in a variety of designs and ratings. They are also applicable to engine drives.

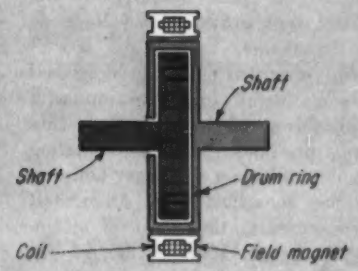
Controlled torque is desirable where: (1) a starting shock may damage driven machinery, interfere with its proper functioning or cause excessive wear, and (2) a high-inertia load would prolong low-speed high-current operation of a direct-connected motor to an extent where the motor is damaged. A torque converter permits motor to accelerate in normal time while continuing to apply required torque to the load for its longer accelerating period. It is sometimes possible to utilize a smaller motor. Another advantage of torque converters: they function as torque limiters. Load's excessive torque demands after the machine is operating at full speed cause slippage. Torque transients are damped, motor overloads can be prevented.

Hydraulic fluid coupling has been developed in many forms. In simplest terms it consists of a pump (impeller) connected to the driving-motor shaft, a casing charged with a liquid and a turbine connected to the driven-load shaft. Pump produces streams or jets of liquid which impinge on the turbine runner causing it to turn. Power is transmitted by the liquid stream. There is always some slip (as little as 1% at top speed and full load). Slip depends upon load torque requirements, motor speed and volume of liquid charge. Continuous slip of about 6% is permissible, while 100% slip is possible intermittently without overheating.

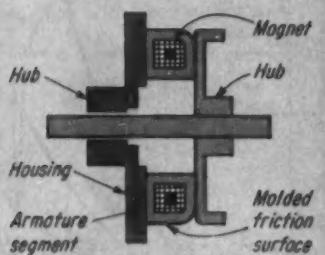
Starting characteristics are excellent. Motor accelerates instantly to about 2/3 its full-load speed, then smoothly accelerates over a longer period. Load accelerates in two seconds to five minutes. Top-speed efficiency is up around 97%. Since there is slip, there is some heat loss. Hydraulic fluid couplings are available up to 500 hp, 600 to 6000 rpm.

Dry fluid coupling, see drawing and curves on p 82, consists of two parts: housing connected to the motor, serving as driving member; rotor connected to the driven load. A measured amount of fine heat-treated alloy-steel shot is used as a fluid. This steel shot or flow charge is contained in the housing. When motor starts, centrifugal force throws the flow charge to housing perimeter. It packs in between housing and rotor, transmits power from the driven housing to the rotor. Rotor is crimped to aid in engaging the compacted shot. When a certain speed is achieved, slipping stops and shot locks rotor and housing together.

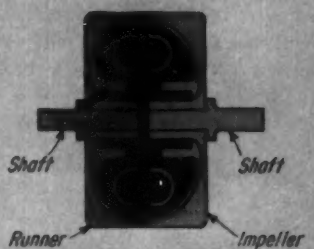
Coupling torque capacity can be adjusted by changing the charge of shot (easily done on the job). Adding more charge increases coupling's torque capacity. In this way you can vary time of acceleration and point when coupling will slip under overload. Three typical flow-charge settings are shown on curve, p 82. The *maximum-duty* setting takes advantage of motor breakdown torque for



EDDY-CURRENT coupling has poles excited in one member, current induced in other



MAGNETIC clutch depends on attraction between rotating magnet and armature



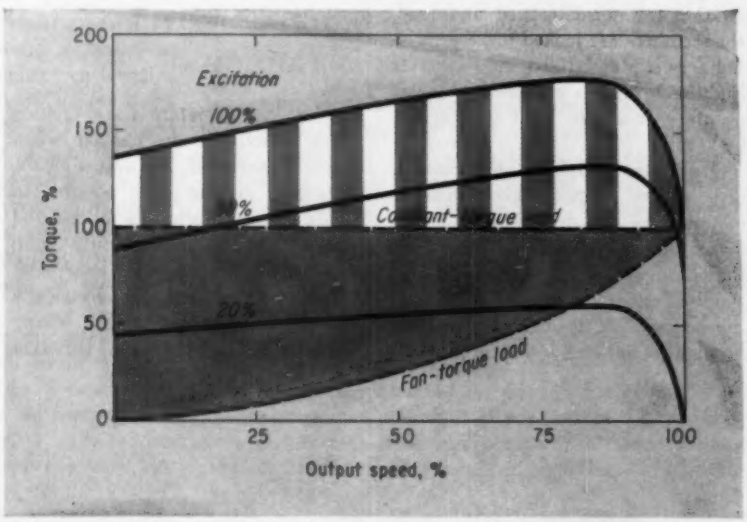
HYDRAULIC drive transmits torque through liquid driven by impeller against runner

By NORMAN PEACH
Associate Editor

very hard-starting loads. *Minimum* gives (when sufficient to drive the load) less than rated full-load motor torque for especially smooth starts and close overload protection. When used with settings above *normal duty* torque, motor speed will be pulled down considerably below full-load.

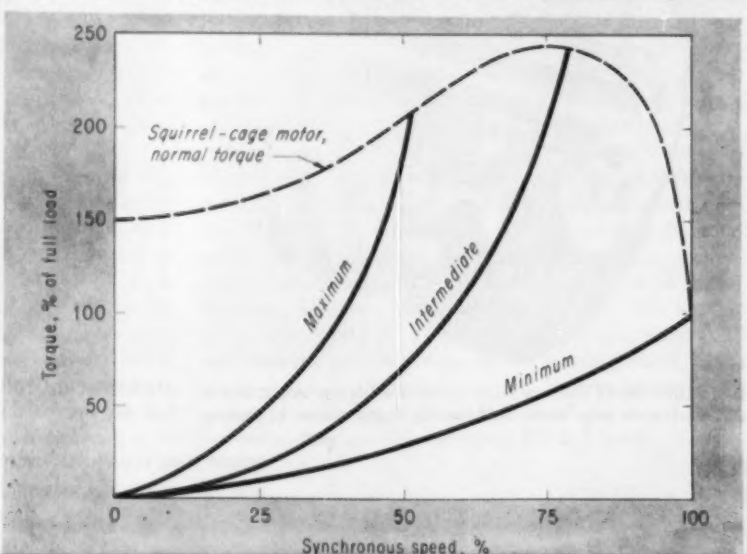
Dry fluid coupling's torque capacity varies with input speed and doesn't for practical purposes vary with output speed. When input speed is constant the output torque will be substantially constant. Set to deliver a certain torque, it will deliver this torque during the total time required to accelerate the load. This is one of its main differences from hydraulic fluid drives. [Another difference: dry fluid couplings are unaffected by temperature changes or atmospheric pressure.]

Running efficiency is 100% because there is no slip at full speed. Accelerating times vary from 1 second to 8 minutes depending on coupling size and number of starts per hour. [A thermal relay is available which operates separately mounted control switch to shut down motor if coupling overheats.] Couplings are available up



EDDY-CURRENT-COUPLING curves at rated and reduced excitation indicate wide torque range obtainable. Excess torques are shown for accelerating constant and fan type loads

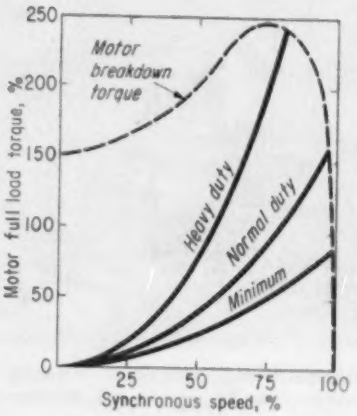
HYDRAULIC-COUPLING characteristics can be altered by adjusting the amount of fluid charge. Higher torque, within safe operating limits, is developed at higher slip values



to 1000 hp, 500 to 3600 rpm.

Magnetic-particle clutch utilizes a magnetic field instead of centrifugal force to compact the dry fluid (steel particles) which transmits the torque. Clutch is controlled by adjusting the electric current producing magnetism. Driving member is connected to the motor shaft, completely enclosed in a housing connected to driven shaft. Driving and driven members are independently supported by stator bearings. The two members are separated by a space of constant dimensions containing the particles. Before exciting stator coil, the particles offer little resistance to drive-member slipping. As control current is increased, shear resistance and bond strength of the particles increases. At full excitation for normal speed and load, the members are locked together, giving zero slip and 100% efficiency. If limiting torque is exceeded, slipping occurs. Units are built to 250 hp, 6000 rpm.

Magnetic - disk clutch has a disk - shaped electromagnet (usually mounted on the drive shaft) and a disk armature (usually on the driven shaft), shown below. Magnetism is supplied either by a coil in the rotating magnet, fed through slip rings, or by a stationary coil across an air gap.

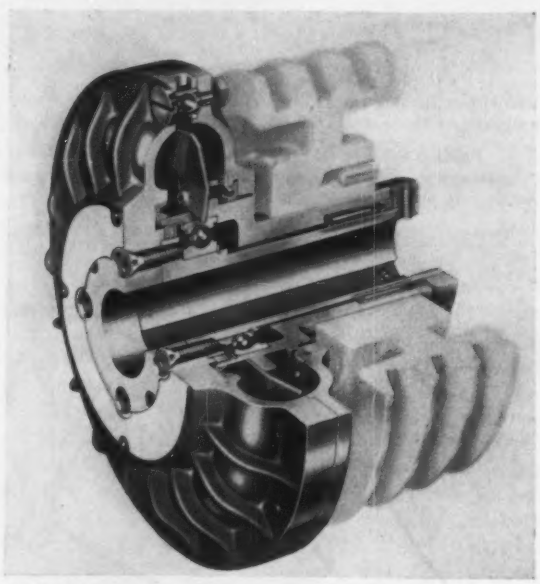


DRY FLUID COUPLING permits selection of curve anywhere between max and min

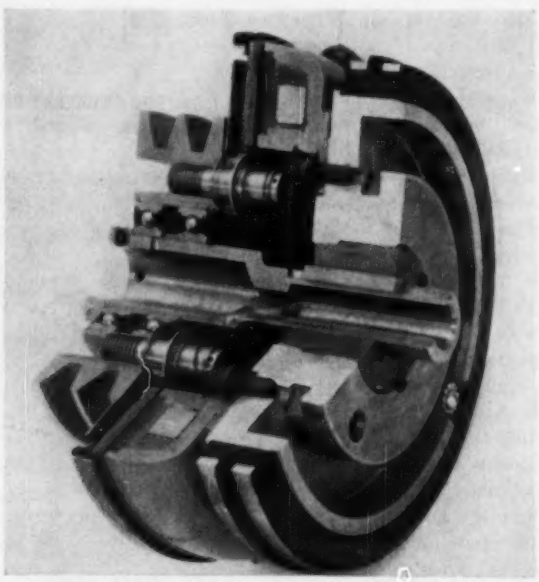
Magnet and armature have friction plates which are in contact when clutch is energized. By adjusting the energizing current it is possible to obtain a constant slip or a millisecond lockup. Device automatically compensates for friction-plate wear. Accelerating rate can be electrically adjusted, and with proper setting clutch is torque limiting. Different designs are available up to 200 hp and 10,000 rpm. Rectifiers in the control unit provide low-voltage dc for the magnet.

Eddy-current coupling (described in some detail in connection with adjustable-speed drives, POWER, July 1960, pp 63-68) has two rotating members within a stationary housing. Member connected to the drive shaft corresponds to the stator of an induction motor. Member connected to the driven shaft behaves much like a rotor. A stationary dc-energized field coil provides magnetization, controllable by adjusting the energizing current. Couplings have excellent starting, accelerating and torque-limiting characteristics. There is always some slip (about 5%) and 100% continuous slip is permissible. Typical efficiency is 80-85% with higher possible at top speeds.

Permanent-magnet eddy-current couplings are made in 1- to 15-hp range. Characteristics are similar to excited couplings, but simplicity has been gained by giving up control. Minimum running slip is 1%; continuous 30% slip is allowed. Efficiency is between 90% and 100%. These couplings are suited to reversing duty and motor plugging to brake the load.



DRY FLUID DRIVE operates same as coupling but has output sheave concentric with input shaft. Ball bearing supports rotor in housing



MAGNETIC-CLUTCH-PULLEY unit is constructed with magnet, coil and slip rings as input assembly, armature and pulley on output

By C C WHELCHEL
Chief Mechanical Engineer
Pacific Gas and Electric Company

PG&E's nuclear power program—investigation, innovation, construction, public information

The generation of large quantities of electric power by controlled nuclear fission is fast becoming a reality in this country. With government and industry each active in R&D, nuclear energy has been developed to the point where competitive electric power from this source in high-cost-fuel areas is confidently expected within the next five years. Investor-owned electric companies have played a vital part in bringing this about. Numerous examples could be given, but my comments will be confined to those in which Pacific Gas and Electric Company is participating because these are projects with which I am intimately familiar.

Early in 1951 we were a partner in one of the first four industrial teams to study the feasibility of applying nuclear energy to electric generation on a commercial basis. These studies were followed by the formation of Nuclear Power Group (NPG) made up of seven private utilities and one consulting engineering firm; at that time there were no equipment manufacturers in the field of commercial atomic power. One of the major projects of the group led to the building by Commonwealth Edison Company of Chicago and NPG of the 180-mwe Dresden boiling-water-reactor power plant now in operation at rated power. My company shared substantially in the R&D work for this plant.

In 1957 the first privately financed atomic power plant was put in operation at Vallecitos, California as a co-operative project between PG&E and General Electric. Operation is under AEC license No. 1. It is a bwr plant of 5-mwe capacity and now has generated over 25-million kwhr.

Next was a 50-mwe bwr unit at our Humboldt Bay Power Plant near Eureka, California. Eureka is somewhat isolated from the rest of the system and is supplied by two 50-mw conventional steam units and two rather long and exposed 110-kv transmission lines. Fuel oil is more expensive here than elsewhere in our system. It was concluded that this plant provided a good location for a nuclear unit; its cost is estimated to be about $20 million.

After deciding to proceed with Humboldt we became interested in a concept of reactor containment known as *pressure suppression* because it showed promise of reducing space needs and plant cost and has important safety advantages over conventional dry containment. In the improbable event of accident, escaping steam would be quenched in a water pool—limiting pressure rise. But a test program was required to demonstrate that the pool would actually condense all the steam, and PG&E undertook this program, investing about $400,000 in research, design and testing. The program has now been successfully completed and results are incorporated in the Humboldt Bay plant design.

We are participating in the 40-mwe high-temperature gas-cooled-reactor project at Peach Bottom, Pa. and also have under study a nuclear plant of 300 mwe or more for construction in the San Francisco Bay area within the next five years.

Because PG&E believes that it is important to help lay a base for healthy public acceptance of nuclear electricity, we have been conducting a broad information program designed to keep the public aware of our plans and activities. Included in this program are talks before service clubs, technical societies, community meetings and other groups; a motion picture of Vallecitos was viewed by over 100,000 people; more than 14,000 have toured our Vallecitos Atomic Power Plant. With an eye toward the future, these tours concentrated on college and high-school engineering and science students.

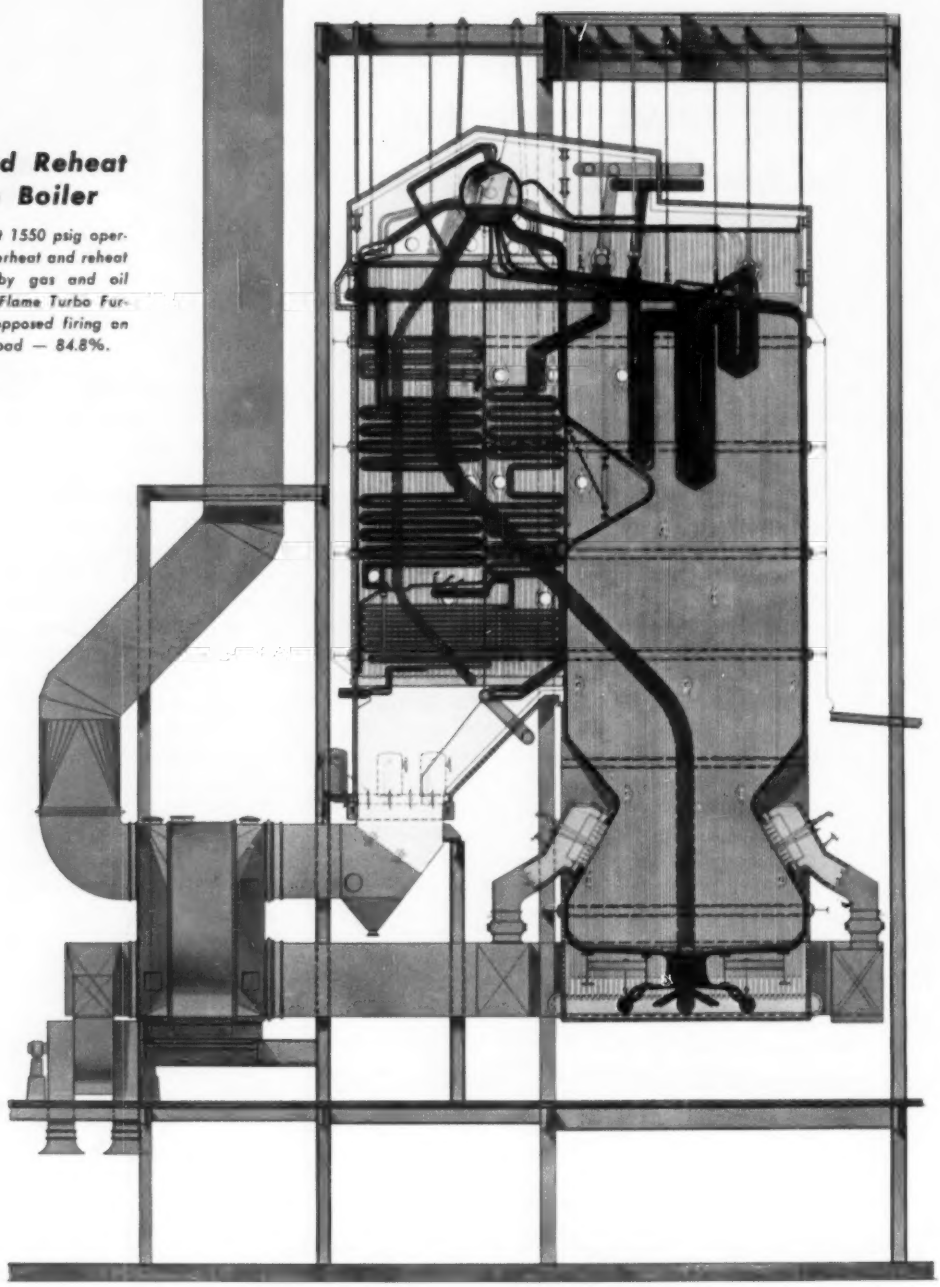
Although research scientists are constantly adding to our store of fundamental knowledge and industry is making important strides in commercial nuclear power, the art is still in its early stages of development. Its competitive position will improve with experience, technological advances and the economics of increased manufacturing volume. There is great promise that nuclear power plants will be providing a substantial amount of our nation's electric needs in the coming years; such plants will take their place as they become economically competitive alongside the conventional steam and hydro resources that are now carrying the full load.

Located In the Great Permian Basin Area of West Texas

This Riley TURBO FURNACE Boiler can be converted quickly to coal

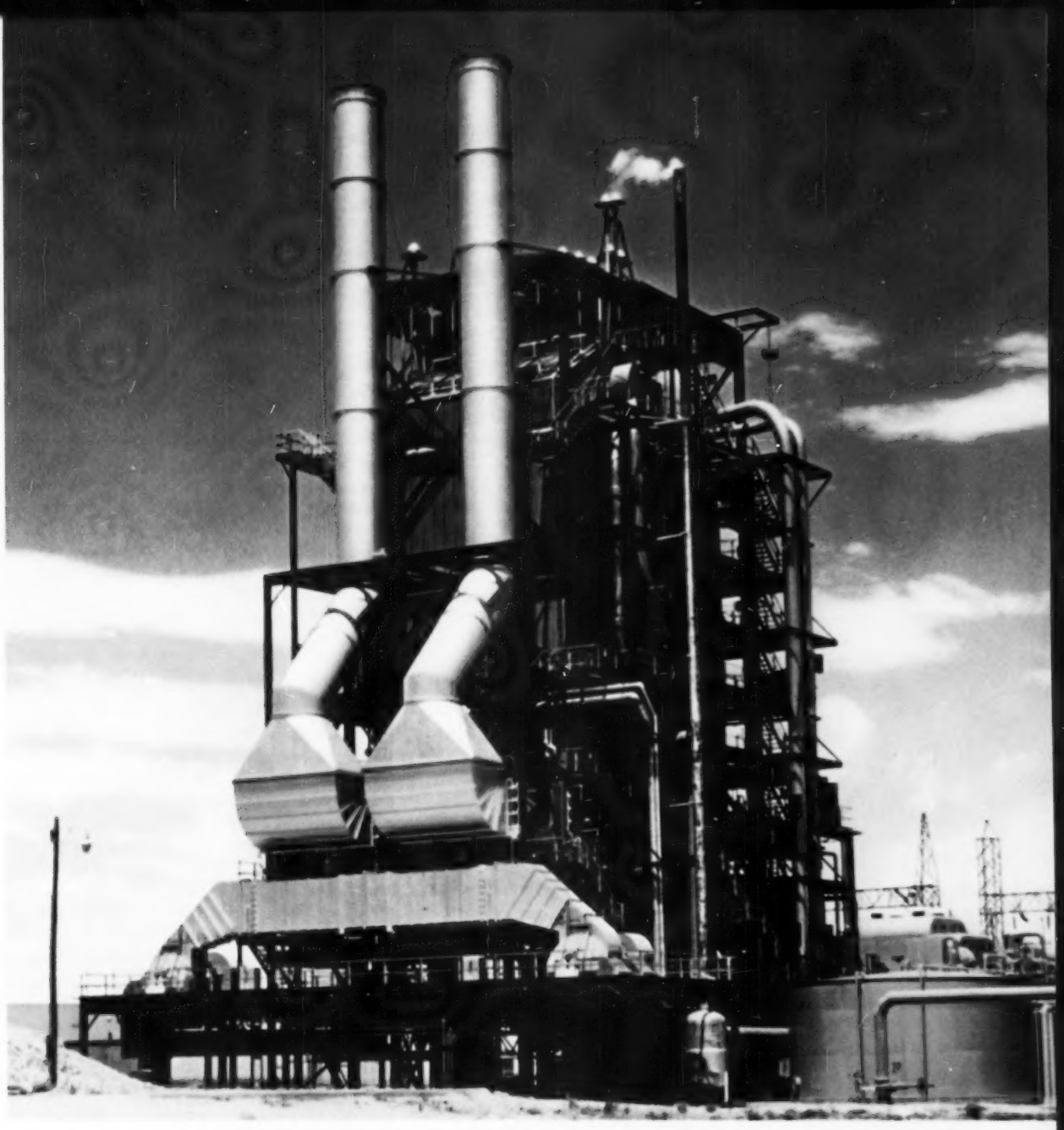
Riley Pressurized Reheat Turbo Furnace Boiler

Capacity — 825,000 lbs/hr at 1550 psig operating pressure and 1005F superheat and reheat steam temperatures. Fired by gas and oil through 12 Riley Directional Flame Turbo Furnace Burners positioned for opposed firing on one level. Efficiency at full load — 84.8%.



Ask your Riley representative for detailed information about Riley Turbo Furnace Boilers — or write direct to RILEY STOKER CORPORATION, WORCESTER, MASSACHUSETTS.

Sales Offices: Boston, Charlotte, Chicago, Cincinnati, Cleveland, Detroit, Houston, Jacksonville, Kansas City, Los Angeles New Orleans, New York, Philadelphia Pittsburgh, Portland, Salt Lake City, San Francisco, Seattle, St. Louis, St. Paul, Syracuse.



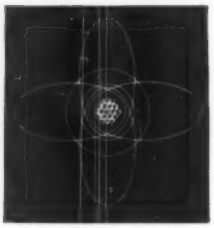
Burning gas and oil now, it may someday become both practical and economical for Texas Electric Service Company to fire its new Riley Turbo Furnace Boiler at Permian Basin Steam Electric Station, Monahans, Texas, with coal.

Because of the Turbo Furnace's unique multifuel characteristics this unit can be quickly and inexpensively converted to coal firing: combustion of coal, oil and gas produces substantially equal furnace performance with equivalent furnace exit temperatures simplifying steam temperature control changes; in addition the ability of the Turbo Furnace to stay clean and slag-free eliminates the need for slag-blowing equipment and sustains an efficient furnace performance indefinitely.

A careful survey of your plant by a qualified consulting engineer could show ways of making substantial savings in power costs.

RILEY

STEAM GENERATING & FUEL BURNING EQUIPMENT



Nuclear notes

By B G A SKROTZKI, Associate Editor

Proposed nuclear plant for manned space exploration would be no bigger than a watermelon says General Electric's Atomic Power Equipment Department. The plant would generate from 5 to 30 kwe by direct conversion of fission heat to electricity. Modular design of the plant makes it possible to expand up to 300 kw. The plant consists of a self-regulating high-temperature nuclear reactor radiating heat at over 3100 F to a surrounding shell of thermionic cells. This would generate power to run radio receivers, transmitters, television equipment, radiation counters, instruments and life-support equipment. Reactor is a thick-walled graphite cylinder with a hollow central cavity. The fuel, solid compound of uranium or plutonium in pellet form, is encased in channels in the cylinder wall. No fluid or gas coolants needed.

The United States offers to place the Brookhaven Graphite Research Reactor, Brookhaven Medical Research Reactor, Argonne Experimental Boiling Water Reactor and the Piqua Organic Cooled and Moderated Power Reactor under the provisionally approved safeguards system of the International Atomic Energy Agency. Offer was made to demonstrate the workability of Agency safeguards. The IAEA safeguards provide for reports and inspections. They've been developed to assure that nuclear assistance made available through the Agency is not used for military purposes. Principles and procedures are limited to research, test and small power reactors, to source and special fissionable material used or produced in these reactors and to small research and development facilities.

Military reactors in the U.S. will be used for highly specialized purposes. They will provide propulsion power for combat surface and submarine vessels, for manned aircraft and missiles, for overland and space vehicles. They will furnish heat and electricity at remote land installations, for unmanned weather installations, undersea communication lines, space satellites and other needs. Military reactors must demonstrate reliability, mobility and portability. The AEC and the Army are now trying to develop a reactor plant which can propel an overland train and other vehicles. We now have 13 nuclear-powered submarines running, 20 being built and 13 more authorized by Congress. The surface fleet includes nuclear-powered aircraft carrier, guided-missile cruiser and destroyer.

Hanford's new production reactor near Richland, Wash. could produce 900 mwe according to General Electric Co designers. The $145,000,000 reactor will produce plutonium, but convertible features make it possible to add equipment for producing electric power. Reactor is over 5% complete and the design work over half finished.

Small reactors study by AEC shows that they have a difficult road ahead. Up to about 1970 small reactors of 40 mwe and less can produce electricity in the range of 13 to 16 mills per kwhr. This compares with about 11 mills per kwhr for same-sized conventional plants.

Two new AEC bulletins might be worth looking up. "Energy from uranium and coal reserves" (TID-8207), 7 pages, costs 50c; "Nuclear reactors built, building, or planned in the United States as of June 30, 1960" (TID-8200), 23 pages, free. Order the first from Technical Services, U.S. Dept of Commerce, Washington 25, D.C. and the second from Technical Information Extension, U.S. AEC, PO Box 52, Oak Ridge, Tenn.

It's Horse Sense . . . Why Chance Leaks in Seat Rings

Get Monel Seat BRONZE GATES made the way JENKINS makes them

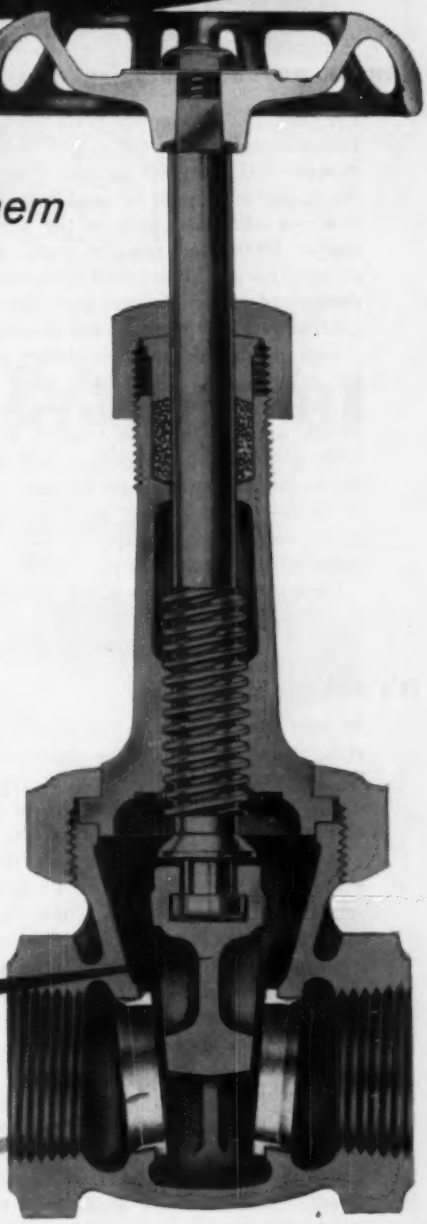
It's plain horse sense that you had better have the Monel seat rings EXPANDED (ROLLED) into the valve body if you want them to stay tight and leak-proof.

More horse sense . . . there's nothing valuable lost through having seat rings that can't be replaced by a regular maintenance man . . . **IF** the bronze or nickel alloy wedge has a lower degree of hardness than the heat-treated Monel seat rings. *(The way Jenkins makes them)* Then, the wedge takes the wear and seat rings are relatively unaffected.

Obviously, there's no faster, simpler or cheaper way to renew tightness and efficiency than to slip on a new wedge. And that, plus renewal of packing as needed, is all you need do to assure good performance from Jenkins Monel Seat Bronze Gates for as long as you'll need to care. Good service for scores of years is common.

Long, low-cost life also results from greater-than-ever-needed strength in every part of these valves. The records of millions of Jenkins Bronze Gates show you get full protection against all the stresses encountered in use.

Your local Jenkins Distributor will quickly supply your needs from a wide variety of Jenkins Bronze Gates. For information about these valves, write for folder No. 181-C. Jenkins Bros., 100 Park Ave., New York 17.



WEDGE is less hard than seat rings. Wear affects this easily replaceable part . . . NOT seat rings

SEAT RINGS are expanded (rolled) into body. Permanent, all-around support is essential to prevent deforming, loosening, shifting, LEAKS

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Reserved for your comment

BOB BELLAS, Associate Editor

Shucks, anyone coulda' done it

I've been a POWER fan for years but in all that time I've never taken time out to give you folks a word of appreciation for the pleasure I've received from the magazine. I want to mention particularly Lou Rowley's editorials, such as the one in the September 1960 issue (*Lowest price, highest cost?*, p 63). This one hit me dead center since I'm in the design end of the business now; but my first and greatest love is operation and maintenance.

George Edwards' musings always give me pause for thought, too. I especially liked the piece he wrote some months ago about how many low water cutouts are enough (*How much is 6 x 0?*, March 1959, p 196). All the gadgets and engineering in the world can't compensate for one competent conscientious operator. But until we find that individual in quantity it appears that gadgets and engineering will have to try.

One more comment: your tear out pages—terrific!

L A WATSON
Eastern Engineering Co, Atlanta, Ga.

It's *not* the humidity . . .

In your September issue you refer to motors operating on single-phase. The statement is made in the last sentence of the first paragraph. "Preventing trouble is simple: use overload protectors in all three phases" (*Electrical Fact File*, p 248).

In our experience in serving approximately 54,000 sq mi and many long rural lines where single-phasing can occur, we have not found overload protectors in all three phases to be a sure cure. A short while ago we asked the major control manufacturers to specify any overload protector which they would guarantee to take care of the single-phase condition. Each stated they did not have such overload control. Consequently we designed a static relay system which would protect 3-phase motors when operating on single-phase, but this was more expensive than standard unbalanced current protection with an auxiliary relay which gives a simpler circuit. We have found these relays to be entirely satisfactory.

Referring to your illustrations, the reasons the overload protectors do not always take care of this condition are: Overload protectors in switches give this protection when the control is normally set for full-load current on the motor, seldom occurring except in special applications. Assume an rms average of 70% load on a motor which begins to single-phase. Current will rise to approximately 121% of motor rating which seldom opens the overload control but damages the motor. Our assumption also is that motor and control have the same heat-dissipation characteristics which is seldom true.

Considering a specific application, present-day hermetically constructed motors having forced cooling are good examples. When such a motor shuts down, its forced cooling generally stops, resulting in a temperature rise. If this motor is started again and one fuse blows, the motor temperature in its stalled condition will rise so much faster than that of the protective equipment that the overload protection will not be effective.

B R ASKEW, *Manager, Industrial Sales Engineering Div, Georgia Power Co*

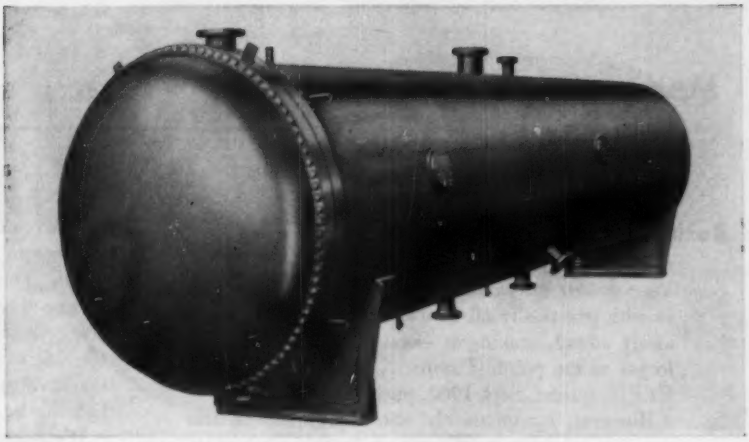
EDITOR'S NOTE: *Associate Editor Norm Peach whose popular Plant Electrical Fact File series started all this allows that the statement "Preventing trouble is simple: use overload protectors in all three phases" is one of those editorial oversimplifications which seem to be unavoidable when presenting engineering information in necessarily abbreviated form. This accounts, too, for the lack of individual protectors in sketches 4 and 5 in the September Fact File.*

The third relay, Norm adds, would solve the single-phasing problem, as such, were the relays perfect devices. As Reader Askew points out, however, current-responsive thermal relays mounted in starters do not detect the actual thermal condition in the motor windings, but attempt to approximate it. Under certain conditions this approximation may not be sufficiently close to protect the windings. Manufacturers recognizing this situation have recommended internal temperature detectors for service where current-responsive overload relays are likely to be inadequate.

Most of the difficulties with starter-mounted overload relays apparently stem from incorrect application or neglect: (1) relay is improperly sized to begin with (2) relays are located in different ambient temperature than motor or where atmospheric contaminants damage them (3) relays receive no maintenance or may be tampered with by operator.

Recently, leading motor manufacturers have promoted use of semiconductor relays embedded in the motor windings. These devices are in series with the starter coil and would prevent starting a motor until its temperature dropped to a safe value. (POWER is investigating user experience and acceptance of this type of protection which we plan to report to our readers.) If such device is successful, it could possibly follow that externally located overload relays will become obsolete.

continued



Photograph of G-R Evaporator and the Bentube Evaporator Tube Bundle, Showing the Slight Initial Bend in the Tubes. The Bend Changes with Variations in Temperature, Flexing the Tubes and Breaking off Scale Deposits.

G-R Scale-Shedding Evaporators

Service Proved G-R Bentube Design Assures Users Many Outstanding Advantages

G-R Bentube Evaporators produce boiler feed make-up water guaranteed at less than 1.0 ppm of dissolved solids efficiently and economically, month after month without additives, regardless of variations in the water supply.

Our design incorporates totally submerged tubes, frequent tube support to avoid sagging, square pitch mounting, adequate clearances, easy descaling, and efficient blow-down. The longitudinal splash baffle, large vapor space and G-R's exclusive patented centrifugal separator effectively remove any last traces of moisture, producing a pure, dry vapor.

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More **comment**

Bothered with stiff joints?

Your article on pumps was quite interesting. And as with practically all POWER articles, this one was nicely edited, making it easy for the busy reader to get to the point (*Pumps . . . the heart of your HTHW system*, Sept 1960, pp 88-89).

However, conspicuously absent from the article was any reference to the use of flexible connectors between pumps and pipelines on suction and discharge sides. The omission is readily understandable because the author is primarily interested in pumps. At the same time, I feel that it would not have been amiss to mention the fact that flexible connectors often spell the difference between a successful and troublesome installation. They help avoid failures caused by vibration, expansion and contraction stresses and misalignment. As their name implies, they're designed to provide flexibility where piping joins the pump. This is particularly critical in high-temperature hot-water applications where stresses are much greater than in conventional systems.

F CAHN, *Long Island City, N. Y.*

EDITOR'S NOTE: *Reader Cahn is accurate in his observation that the article's author, Mr Broce, was dealing specifically with pumps, not the HTHW system as a whole. It's true that, in addition to pump design itself as discussed by Mr Broce, there are many system-design factors that have a direct bearing on satisfactory HTHW pump life. Reader Cahn cites a very important one—elimination of pipe strains to prevent pump-casing distortion due to widely varying temperatures. And there are many others. Examples: Adequate pump warmup lines are needed to minimize thermal shock as pumps are cut in and out. Bypass design and control must provide adequate flow and be quick acting to prevent shutoff operation.*

Installation of HTHW pumps can also influence degree of satisfactory operation. Foundations must be rigid enough to eliminate vibration. Also, pump-motor alignment must take into account the temperature ranges to be encountered. Centerline support provided by the pump manufacturer will not do the job alone. Inattention to this detail can drastically shorten bearing and coupling life.

It just keeps rollin' along

The article on busways was well done, interesting and quite complete (Oct 1960, pp 80-84).

POWER readers might be interested to know that the roll-in technique of installing busways and lighting fixtures has produced substantial savings in a number of industrial construction projects. According to reports we have received, rolling in of lighting busways and fixtures from one location at one time saves up to 30% in total installation costs. Amount of savings, of course, varies with the size of the job—the bigger the job the greater the savings. We find that rolling in 25,000 ft of lighting busway with fixtures is not unusual.

It's interesting to note, too, that the earlier 'pull-through' technique has been abandoned in favor of a 'push-through' method which effects even greater simplification and savings. Using this technique on the installation referred to in your article, Mr Wilfred Dennis of the Universal Electric Co, Flint, Mich., reports that with proper preplanning of the job and the use of mechanized installation aids, his firm employing a 5-man crew installed as much as 2000 ft of busway complete with fixtures hanging on 10-ft centers in an 8-hr day.

R D FITZPATRICK
General Electric Co, Plainville, Conn.

How to cure the shakes

Your special report on vibration isolation (August 1960, pp 201-216) reflects extensive research and understanding of vibration problems. We compliment you on the scope of the article.

F J CARTY, *Fabrica Products Co, Boston, Mass.*

Like crazy, man!

Mr Mullin's beefing is completely unfounded ("My favorite gripe," August 1960, p 228). He lays the blame for the resultant boiler failure on the "irresponsible boiler operator" who blocked in the low-water cutout bypass button. The real cause goes farther back to the people who allowed the bypass arrangement to be installed in the first place. Installation of this button prevented accomplishment of one of the main reasons for blowing down the water column, namely, testing the low-water cutout.

Mr Mullin should have realized that if he could figure out a "foolproof" method of bypassing a safety device, someone else would come along and devise a method of "bypassing the bypass." Ask the boiler insurance companies!

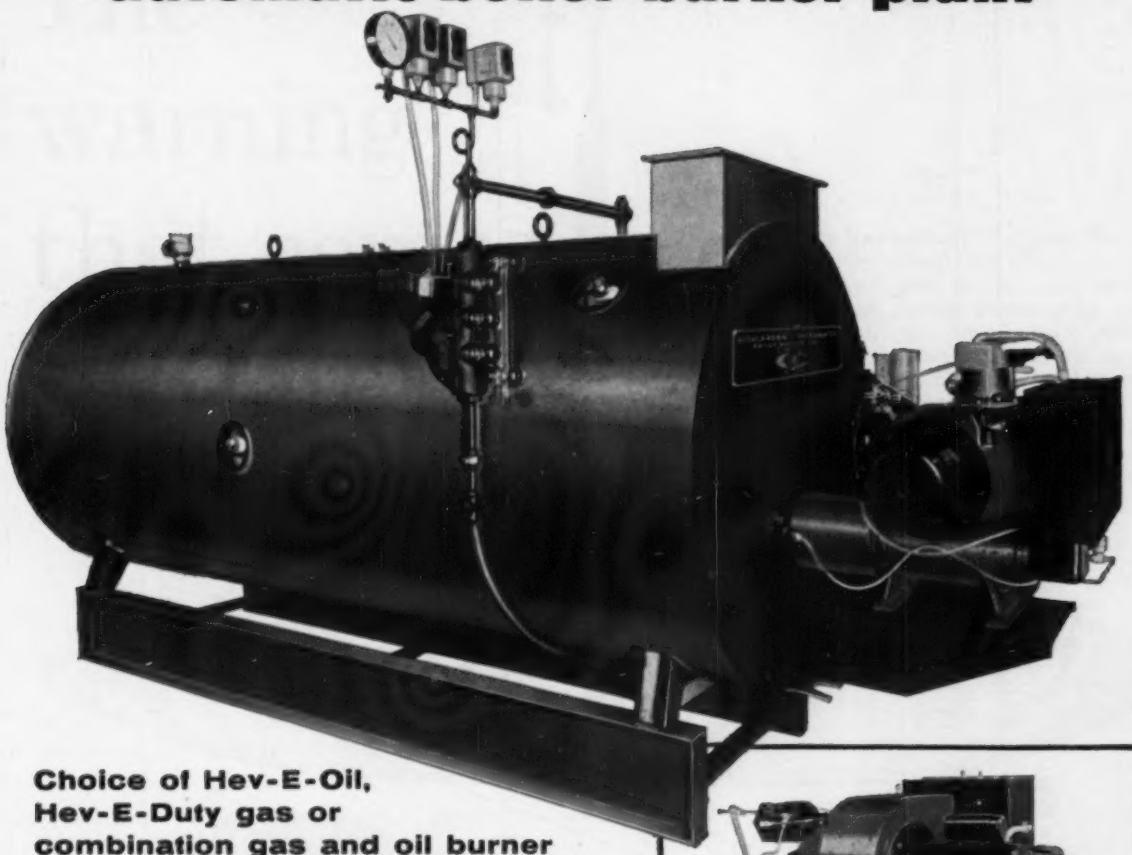
G R DIEGLE, *Marion, Ohio*

. . . Any plant engineer who would permit installation of a device for the *sole purpose* of nullifying potential protection for his boiler has rocks in his head. This sort of thing is, I am sure, one of the reasons that prompted George Edwards' down-to-earth piece on low-water-cutoff maintenance (*How much is 6 × 0?*, March 1959, p 196).

S F MOBERLY, *New York, N. Y.*

NEW HIGHLANDER

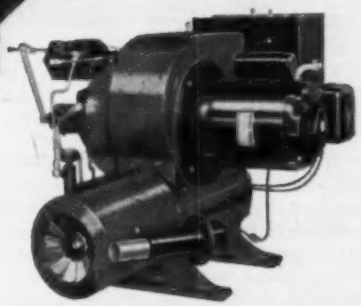
automatic boiler-burner plant



Choice of Hev-E-Oil, Hev-E-Duty gas or combination gas and oil burner

You can rely on this completely automatic unit for *all* heat or power applications. It is built for low pressure or high pressure use — burner to match for heavy oil, light oil, or combinations of gas/light or gas/heavy oil.

The new Highlander is a completely assembled boiler-burner plant (Scotch-type two-pass unit). This combination of boiler and burner brings out the best in operating efficiency and reliable performance. *Simple!* Just two flue passes. *Easy maintenance!* Boiler interior easily accessible. *Reliable!* Complete plant is carefully tested at the factory. *Guaranteed!* Each unit carries a certified rating for output. Entire unit bears Fire Underwriter's label. Write today for complete information — Dept. P-110.



HEART OF THE HIGHLANDER is the famous Industrial Combustion Burner. Shown is the HEV-E-OIL Burner especially engineered to make use of inexpensive heavy oils. Available from 5 to 150 gph. HEV-E-DUTY POWER GAS BURNERS and combination gas/oil burners in sizes from 720,000 to 21,000,000 Btu.

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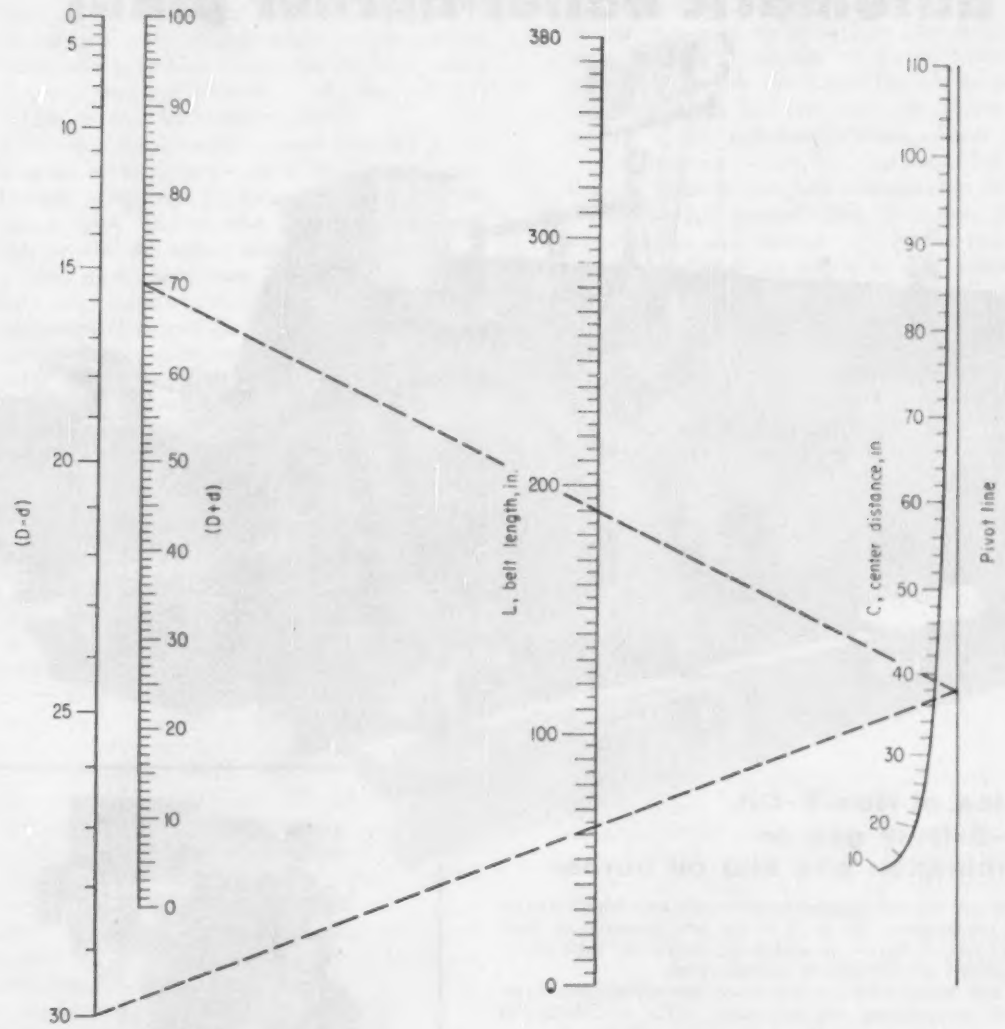
Power's data sheet

No. 338



Find length or center distance of drive belts

Calculation of belt length or center-to-center distance of sheaves is quite simple. However this chart permits rapid selection of belt length without resorting to actual calculations. Chart is based on the formula:

Belt length, $L = 2C + 1.57\,(D + d) + (D-d)^2/4C$

Example: What is the belt length for two sheaves 36 in. apart if their two diameters are 50 in. and 20 in.?

Solution: $(D + d) = 50 + 20 = 70$. $(D - d) = 50 - 20 = 30$. Align $(D - d) = 30$ with $C = 36$ and mark intersection on pivot line. Align this intersection with $(D + d) = 70$, and read L as 188 in.

F CAPLAN, *Oakland, Calif.*

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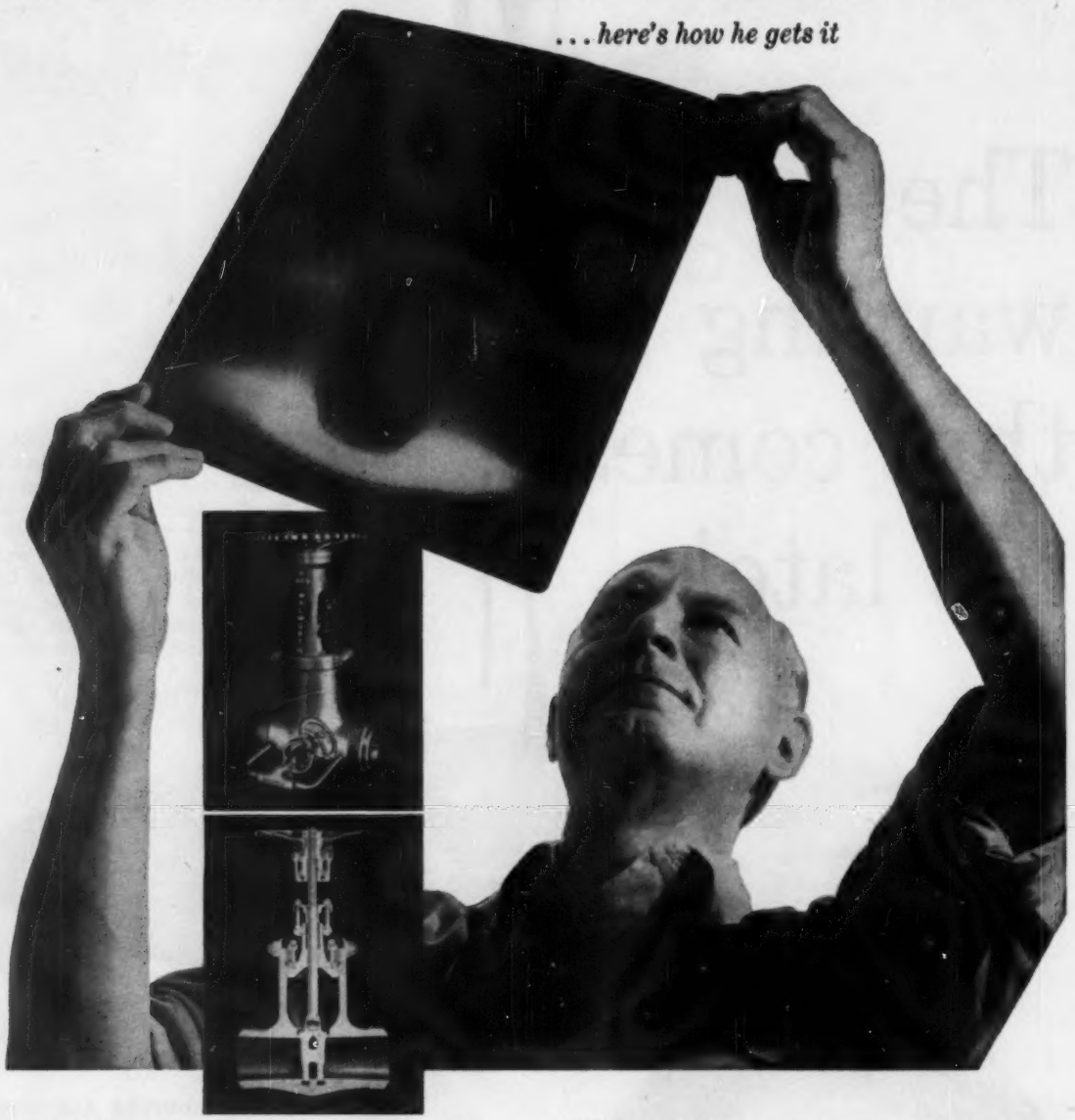

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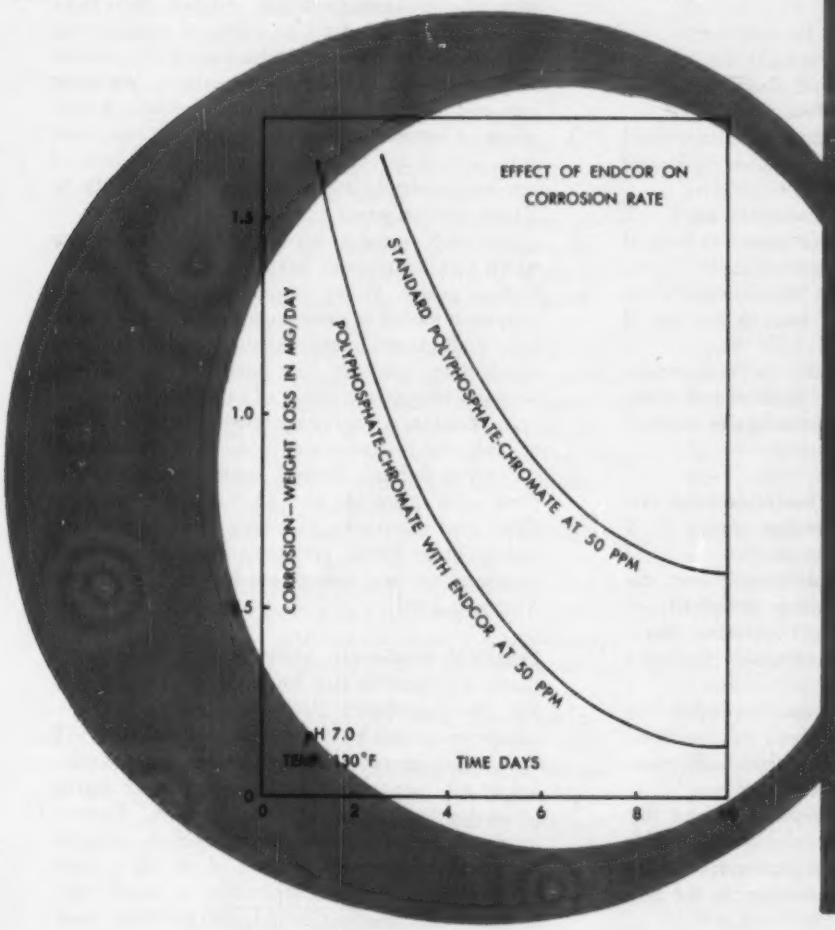

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For more facts circle 248 on Reader Service card, p 103

Technical briefs . . . Latest engineering

Automatic-control concept gains experience in central stations, nuclear-power plants and pipeline-compressor stations

Digital-computer control of the Huntington Beach Steam Station, *A L Guidero, Southern California Edison Company*

Southern California Edison's new Huntington Beach units 3 and 4 combine several advances in central-station design—variable throttle pressure from once-through steam generators, shaft-driven boiler-feed pumps and fully automatic unit control.

Automatic-control study and equipment purchase employed a 5-man team. This automation task force was made up of:

An instrument engineer from Bechtel
An electrical engineer from S Calif. Ed
A mechanical engineer from S Calif. Ed
Two experienced operators from S Calif. Ed

Task force prepared specifications for control equipment, analyzed bids, recommended equipment and coordinated design efforts.

Huntington Beach automatic-control units will provide (1) cold start (2) hot start (3) normal shutdown (4) emergency shutdown and (5) supervision of normal operation. 900 plant variables will be scanned continuously—some at the rate of 300 per sec.

Boiler, turbine-generator and boiler-generator control systems are detailed; effect of automatic control on control-room size and design is covered. *ISA, San Francisco, 1960*

Latest design concepts for boiler-control systems on large steam-generator units, *E D Scutt, Leeds and Northrup Company*

Boiler-control systems have developed over the years to keep up with increasing complexity of modern central-station design and operation. Major system components include combustion, feedwater and steam-temperature control.

Direct-energy balance concept developed for once-through steam generators forms a logical basis for the next step in control systems. Fully automatic controls to provide input are:

(1) Digital-computer assembly for normal logging and performance calculations. The assembly will additionally program starting and stopping functions but only supervise operation in the normal load range.

(2) Integrated boiler-turbine control system of the analog type to directly regulate major auxiliaries within their normal operating range.

(3) A dispatch computer control to economically load each operating unit in the utility system.

Overall concept of fully automatic control equipment should embody solid-state equipment wherever economically and technically possible. Plug-in construction of individual components and subassemblies will ease maintenance; equipment designed for rack or cabinet mounting permits maximum factory wiring and functional testing. *ISA, San Francisco, 1960*

Dresden Nuclear Power Station instrumentation, *E P Peabody, General Electric Company*

Instrumentation at the 180-mw Dresden Nuclear Power Station is designed to cope with special operating needs, provide adequate levels of safety for personnel, equipment and station neighbors. Nuclear-reactor instrumentation divides into three power levels, from 10^{-9} to 150% of rated power.

There are two low-level channels. Each consists of proportional counters, preamplifiers, log-count rate and low-level amplifiers and read-out instruments. Channels indicate in counts per min, read from several to about 10^7 counts. Upper limit of low-level instrumentation corresponds roughly to 100-kw thermal power.

Intermediate range is covered by three channels which monitor neutron flux from 0.5- to 60,000-kw thermal power. Power range consists of six channels, each having a gamma-compensated ion chamber, multirange linear micromicroammeter and appropriate read-out instruments. Top current range corresponds to 150% of rated reactor output.

In addition, a battery-operated "blackout" channel indicates reactor power in event of station electric-power failure. Several health-monitoring devices cover plant air and cooling-water emission. Other control systems, including primary and secondary drum levels, primary steam-drum thermal movement and seal leakage are discussed. *ISA, San Francisco, 1960*

Practical heat-cycle analysis and how automatic equipment can be used, *R D Ragle and S G Dukelow, Bailey Meter Company*

Computers providing continuous heat-rate data will show effect of component-equipment deterioration before too many Btu's go to waste. Either digital or analog techniques can come in here. Former, inherently more accurate, lends itself to complete analytical calculations because of its high speed and flexibility. But analog provides an easily interpreted continuous-chart record, uses hardware read-

developments for busy power men

ily maintained and calibrated by station personnel.

Depending on fuel burned and other station design factors, application of automatic continuous heat-rate computation varies widely. Gas-fired units at Pacific Gas and Electric read out in terms of both Btu per kw and $ per kwhr. Coal-fired units at Cleveland Electric Illuminating and Rochester Gas and Electric need more-involved measurement. First, boiler efficiency must be determined and combined with heat output to come up with accurate unit heat input. Only then can input-output calculations be made.

Performance monitors solve some specific operating problems: (1) excess air vs steam temperatures at low loads (2) proper scheduling of auxiliaries (3) detecting very-small amounts of unburned gas (4) optimum control-system stability. Among other advantages, monitors (5) handle some of the work of a test engineer in plants too small to keep one on the payroll (6) keep incremental heat-rate data current. Last but not least, they (7) keep operators economy-conscious. *ISA, San Francisco, 1960*

An automatic-control system for a gas-pipeline compressor station, *K S Hagius and L R Henry, Colorado Interstate Gas Company*

Colorado Interstate Gas has an industry first: their new central-control system for a gas-pipeline compressor station. Preliminary studies covered industry attitudes toward automatic control, modes of control required and existing equipment's capabilities and limitations.

They reviewed both set-point and supervisory control concepts. Latter has a disadvantage—utter dependence on continuous communication channels. The set-point concept is relatively free from this disadvantage since only one selected condition is remotely determined—station control equipment makes the remaining decisions.

Control center needs to know several variables to optimize system operation. These include: (1) suction and discharge pressure at each station (2) rates of flow wherever they're measured (3) indications of quality at input and mixing locations and (4) any loss of capacity with compressors out of service.

Both analog and digital telemetering were studied. Cost and reliability indicated digital telemetering using solid-state electronics. And likely future use of an on-line computer complete with digital input, output, memory and arithmetic threw its weight on the digital side.

Directions for ordering these papers on p 102

Control philosophy and hardware is detailed: (1) telemetering and logic equipment (2) controller-logger cabinet (3) engine selector (4) engine-sequence controls (5) control battery and power supply (6) terminal panel and (7) local control panel. Interstate had to modify compressor and auxiliary-generator control; the why and how are discussed.

Successful operating record: April '60 to date. Tests have covered all conceivable operating situations, so no difficulties should crop up during high-load winter months. *ASME 60-PET-15*

The logical approach to the commissioning of control systems, *W J Kerchner and R M Maust, Gilbert Associates, Reading, Pa.*

You'll get full value out of a control system only if it's fully commissioned at the time of initial unit operation. Unfortunately, this is rarely the case during the critical startup period. The full potential of control, interlocking and safety features usually is not available to operators initially; its absence unnecessarily increases risk of physical damage, hazard to personnel and investment loss.

Only through a logical approach to commissioning control systems can you realize this optimum condition. Five steps will give the desired end result—control system fully commissioned at the time of unit startup. Take them in order and thoroughly: (1) conception (2) procurement (3) engineering (4) installation (5) prestartup. Details of each step include required action by each group concerned: vendor, consulting engineer, operator and owner. *ISA, San Francisco, 1960*

Control and data systems for large steam-generating units—design concepts and total-system philosophy, *T N Nourse, Hagan Chemicals and Controls, Inc*

Failure to view automatic control (analog control, panels and data-processing-computing system) as a complete unit can run up size of control room and operating console. For maximum benefits and savings, check these out: (1) Startup date *must* be met. (2) What degree of reliability do you want? (3) Make an overall review of actual control needs—see they're met with compatible equipment. (4) Can equipment handle both programed and unprogramed load changes? (5) Install equipment within the capabilities of operating and maintenance personnel—if they lose confidence, you can find yourself in real trouble.

Specific cases support the complete-unit concept. Equipment construction features are covered to show some ways of gaining desired reliability level. *ISA, San Francisco, 1960*

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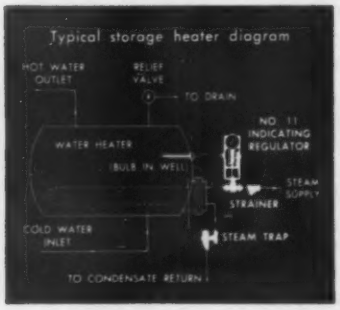

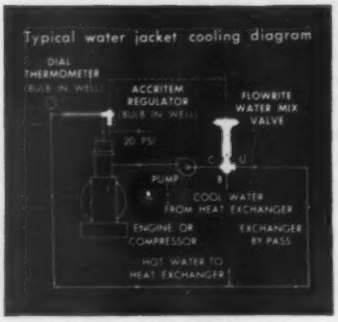

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Technical briefs

Begins on page 96

Flame supervision

Successful flame supervision, *Ross Forney, Forney Engineering Co*
Recent furnace explosions point up need for burner control systems which maintain continuous flame supervision of each burner. To be successful a flame supervisory system must embody: (1) ability to detect loss of flame (2) capability to react immediately and shut off fuel and air (3) minimization of nuisance shutdowns through high-quality components (4) individualized systems for each burner to prevent total tripping unless necessary (5) incorporation of continuous self-checking system (6) prevention of burner recycling until all permissive conditions are satisfied (7) complete integration with purge and fuel safety system and (8) comprehensive maintenance programs.

Furnace design and fuel differences require individually engineered control systems. Some must be designed for maximum response in the ultraviolet or blue-flame range. But certain arrangements do not provide an appreciable amount of blue flame, so response range must be shifted. Maximum value of a flame detector is wasted if it trips an alarm system only; a self-contained logic system must also be incorporated to shut down fuel and air flow immediately.

In a large steam-generating unit about four hr per wk should be devoted to a flame-detector preventive-maintenance program. Only a program which simulates all possible failures will insure maximum system reliability. *ISA, San Francisco—1960*

Preventing furnace explosions, *W L Livingston, Combustion Engineering, Inc*
Any of four operating conditions can produce a furnace explosion or "puff" (very high heat-release rate): (1) inadequate or improper sequencing of initial and subsequent ignition (2) interruption and reoccurence of combustion reactant mixtures (3) fuel delivered to combustion chamber improperly prepared to ignite and burn with the given burner-furnace design (4) fuel and air delivered to the fur-

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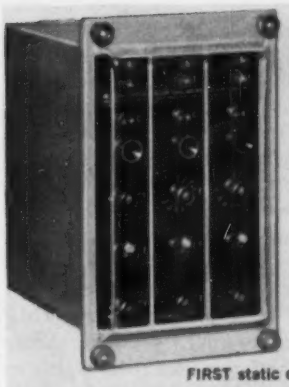
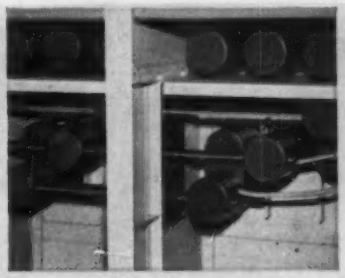


FIRST static overcurrent relays



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FIRST Aluma-Clad walk-in aisle switchgear

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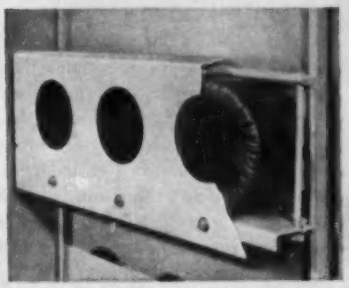
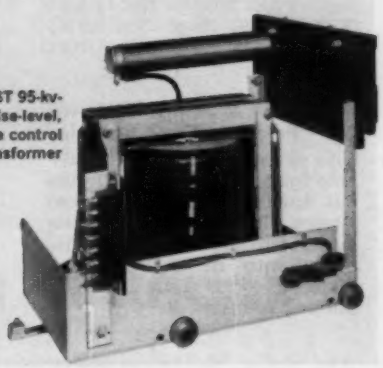


FIRST 95-kv-impulse-level, dry-type control power transformer



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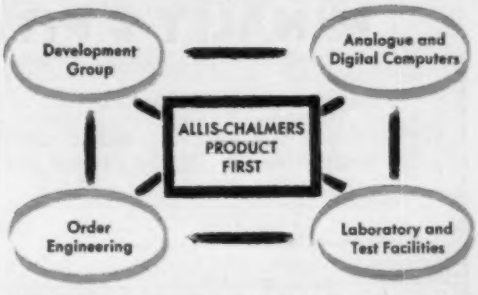

Intradepartment teamwork bridges all gaps ... smoothly integrates information, machines and men ... speeding overall progress in Allis-Chalmers switchgear.

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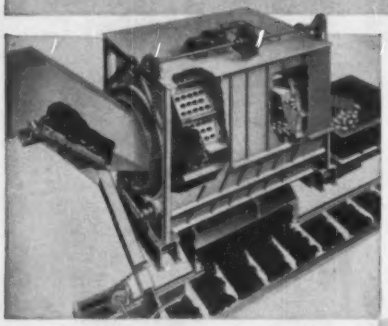
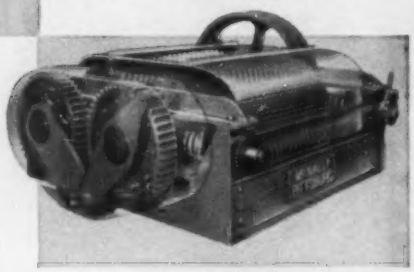
More and more utilities now use this

Rugged Cost Cutting Coal Processing Equipment



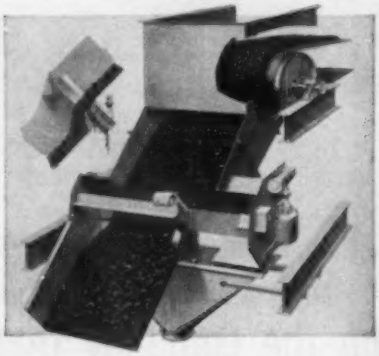
McNally Pittsburg Rotary Breaker

This heavy-duty unit allows positive control of top size in handling run-of-mine washery feed. Production of fines is held to a minimum. Without center shaft or spoke interference, costly maintenance is usually drastically reduced.



Gearmatic Stoker Coal Crusher

Built to handle heavy coal tonnages, these crushers have proved most efficient to reduce 8" minus to stoker grades. They offer three major advantages: 1) high volume production; 2) accurate sizing; 3) low percentage of fines.



McNally Pittsburg Primary Coal Sampler

This automatic sampler (adjustable from 1 to 30 minutes) cuts out true samples of the coal stream. Cutter opening permits largest particle of stream to pass freely into cutter. Conveyor discharges into chute in which sampler is installed.

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Technical briefs

Begins on page 96

nace in noncombustible ratios or improperly combined to promote desired ignition and firing pattern.

Three-dimensional graphs — air, fuel and ignition energy—show operating techniques which can lead to a furnace puff.

Current methods of preventing furnace puffs have several shortcomings. They are generally unable to establish whether ignition systems are actually capable of properly igniting and stabilizing a burner's operating condition. And they are unable to determine quickly enough whether flame failure has been due to rich or lean furnace mixture.

Four basic requirements for puff prevention are given to produce an effective, practical flame safeguard system. *ISA, San Francisco—1960*

Management and maintenance

Models—a basic tool in process-plant design, *D J Fries, Foster Wheeler Corporation*

Four basic industrial model types are available to aid plant design—plant layout, check, display and piping layout. Last is widely used to replace extensive planning drawings. Normal scale is $\frac{3}{8}$ in. equaling 1 ft or larger; steps in model production include plot-plan preparation and study of structures, pipe supports and equipment. Then model shop has all equipment and structural elements scaled and mounted on a base in accord with the plot plan. Color coding inhances model's usefullness in all stages by providing ready means for identifying components.

Industrial models find many uses in design- and product-engineering groups as well as in discussions with customers. Also plant operators and maintenance people need not await the finished plant to start training—the model can be used. This saves considerable time between plant completion and startup.

As engineering inertia resisting use of models breaks down, models will be more and more widely used in all phases of industrial planning and personnel training. *ASME 60-PET-3*

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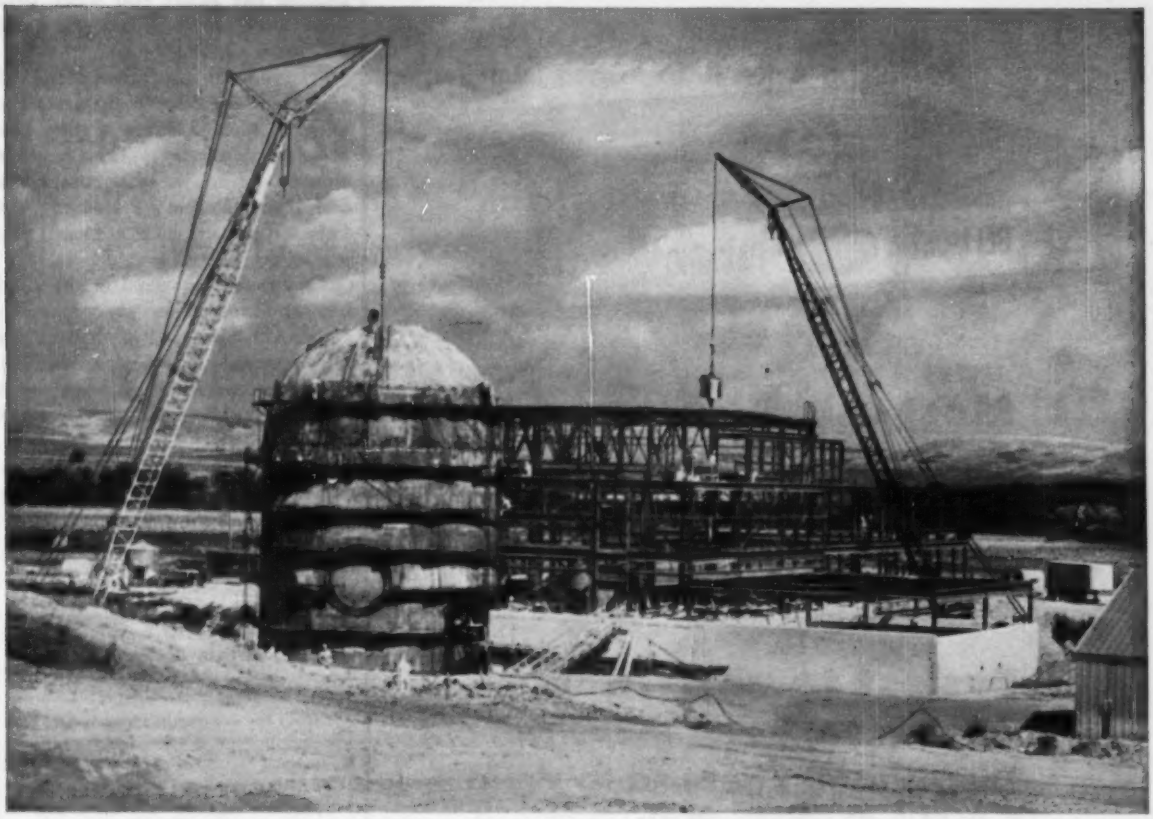

A status report:

nuclear superheat...on schedule

"Pathfinder" is the country's first nuclear superheat power station under construction. It is being built by Allis-Chalmers for Northern States Power Company. Cooperating in research and development are nine other midwest utilities* and the Atomic Energy Commission.

The above photo shows the containment, turbine, water treatment and administration buildings. Construction is on schedule.

The integral nuclear superheater will provide steam at 600 psig, 825 F. Other important design characteristics include a high power density — 46 kw per liter — and controlled recirculation — 60,000 gpm.

Only Allis-Chalmers has experience in both direct- and indirect-cycle boiling water reactors, fast breeder, gas-cooled and process-steam reactors and fusion. In addition, A-C has long been a leader in such steam plant equipment as turbine-generators, condensers, pumps, valves and water conditioning systems.

For more information about Allis-Chalmers facilities and capabilities in the nuclear power field, talk to your nearest A-C representative, or write for *Bulletin 43B9541,* **Allis-Chalmers,** Atomic Energy Division, Milwaukee 1, Wisconsin. A-1382

*Central Electric and Gas Co. • Interstate Power Co. • Iowa Power and Light Co. Iowa Southern Utilities Co. • Madison Gas and Electric Co. • Northwestern Public Service Co. • Otter Tail Power Co. • St. Joseph Light and Power Co. • Wisconsin Public Service Corp.

Site of "Pathfinder" plant at Sioux Falls, South Dakota.

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Technical briefs

Begins on page 96

Tests and inspections—are you getting the plant you want, and paid for? *R M Maxin, Day and Zimmermann, Inc*

Shop and preinstallation tests of equipment and plant components can only be money savers if they are properly conducted. This requires close coordination with contractors and manufacturers. Preplanning of tests and inspections is a must if you are to get full value.

Factors to be covered in any good test and inspection procedure include: (1) equipment design criteria (2) materials of construction (3) hazardous conditions (4) equipment location (5) best testing methods and (6) test records.

Table gives testing standards for piping systems carrying various fluids —air, gas, steam and water. *ASME 60-MPE-7*

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- **Instruments**

101 **Mathematical applications** of storage analog computer is topic of 16-p technical report available from Computer Systems, Inc

102 **Plug-in dial timer** and timer which flush mounts to panel are described in sheets 86, 87. Automatic Timing & Controls, Inc

103 **Sequential data-handling system,** 600 channel, monitors bearing, boiler-tube and condensate temperatures of 290-mw boiler turbine generator. Story is in sheet N-07(2). Leeds & Northrup Co

104 **Alarm rotameters,** magnetic and electronic, measure fluid flow rates and warning of abnormal flow rates. Details are in 4-p bulletin 18A. Schutte and Koerting Co

105 **Supervisory instrumentation** for industrial turbines is covered in 12-p bulletin GEZ-3078. Exchange plan for these units is explained in 4-p brochure GEZ-3077. General Electric Company

106 **Metal - sheathed thermocouple** catalog TT-317 lists component parts and typical assemblies of miniature - size models. Trinity Equipment Corp

- **Metals and materials**

107 **Silicone rubbers,** room temperature vulcanizing, are covered in 12-p bulletin S-2. New member of silicone family is introduced. General Electric Co

108 **Silicones** for the chemical process industries are topic of brochure 1-119. Adhesives, paints, water repellants, dust filters are some of product's uses covered. Dow Corning Corp

109 **Graphite cloth's properties** and applications are discussed in bulletin 101. Textile characteristics are tabulated. National Carbon Company

110 **Large-size teflon shapes** are described in brochure. Fluoro-Plastics, Inc

111 **Tensile alloy-steel bar,** 150,000 psi, eliminating heat treating of parts is introduced in 2-p bulletin 22. La Salle Steel Company

112 **Fiber-glass applications,** characteristics, specs are listed in brochure. Applications suggested include vibration damping, mold-

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Gas systems 106
Mechanical transmission systems 106
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Electrical systems 110
Air-conditioning systems 114

ed insulation. Fibrous Glass Products, Inc

● **Insulation and coatings**

113 **Coating** prevents condensation on cold pipes; it insulates, absorbs and releases moisture. Details are in 4-p bulletin available from Chemical Concentrates Div of Baker Industries, Inc

114 **Aluminum jacketing** for insulation protection is detailed in 4-p bulletin ICB. Insul-Coustic Corp

115 **Calcium silicate** and mineral-wool-block insulation for temperatures up to 1900 F are detailed in 4-p bulletin 6451. Product-selection guide is included, shows applications. The Philip Carey Mfg Co

116 **Spray coating** positions and fastens fine wire and foil sensing elements to metal backing, insulates and is erosion resistant. Details are in booklet available from Norton Company

117 **Antirust concentrate** for heavy-duty equipment-cooling systems is described in 8-p brochure. Lubrication Engineers, Inc

118 **How to bond silicone** rubber is topic of 4-p bulletin CDS-245. General Electric Company

119 **Insulating materials** developed from fluoro-carbon resins have temperature range of 250 C to −100 C. Details are given in booklet available from Irvington Div of Minnesota Mining and Manufacturing Co

120 **Silicone-rubber insulating** tape is described in bulletin 18,110. Tables show grades, sizes, tolerances and typical properties. Continental-Diamond Fibre Corp

121 **H-t insulation** for industrial piping is topic of 4-p brochure available from Owens-Corning Fiberglas Corp

122 **Methods and equipment** for testing insulating materials are discussed in booklet G-65 available from Associated Research, Inc

● **Valves, piping, fittings and specialties**

123 **Sliding-gate and plate** temperature regulators for steam, water, air or gas are described in 8-p catalog J180-1. Sizing charts, flow curve and specs are given. OPW-Jordan Corp

124 **Thermoplastic ball valves** are described in bulletin TTp-180. Tube Turns Plastics Inc

Nov 1960 issue **Circle numbers below for FREE data** Card void after Feb 1, 1961

PLANT EQUIPMENT in the news this month, starting on p 120

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NEW FREE LITERATURE continued.....circle key numbers, page 103, for your copies

125 **Forged-steel needle valves** and fittings for 5000-psi service are topic of bulletin 420. American Meter Company

126 **Chrome-alloy pipe,** tubing, fittings and forgings are topic of bulletin available from Capitol Pipe and Steel Products, Inc

127 **Expanded teflon tubing** recovers original dimensions when heated to fit snugly over parts or tubing in electrical, chemical or mechanical applications. Bulletin 3E tells story. Pennsylvania Fluorocarbon Co, Inc

128 **Metallic, protective coating,** corrosion-resistant, for mild steel is described in brochure. This covers use of nickel-alloy-bonded-steel tubing to combat corrosive combustion gases. Includes corrosion-test-data report presented by Detroit Edison Co to ASME. M L Sheldon & Co, Inc

129 **Ductile-iron pipe** is covered in well-illustrated 32-p brochure. Properties and specs are given. James B Clow & Sons, Inc

130 **Welded steel tubing** and solid bars, weight-comparison tables are featured in 4-p bulletin. The Standard Tube Company

131 **Seamless welding fittings** and flanges are topic of 8-p catalog FB-502A. Carbon, alloy and steel types are described. The Babcock & Wilcox Co

132 **Seal catalog** has 34 pp, covers bellows, boot, cartridge and O-ring seals. Cartriseal Corp

133 **Cast-aluminum welding fittings** for installing extruded-aluminum integral steam-traced piping are covered in 2-p bulletin TL-1. Alcast Fittings.

134 **Steel cast-iron collars** to 4 15/16-in. bore diameter have many applications; some are described in 4-p bulletin available from Standard Pressed Steel Co

Gas systems

135 **Single-stage-compressor** bulletin P-13 features 6-step selection method for choosing the proper compressors. Elliott Company

136 **Design considerations,** mechanical and hydraulic, for 3-stage centrifugal pipeline compressors are detailed in 16-p bulletin 187. Clark Bros Co

137 **Drying compressed air** to dew-point −40 F or lower is explained in bulletin describing heatless dryer for pneumatic control systems. Kahn & Company, Inc

138 **Pneumatic pumps** for problem materials are introduced in 4-p book 4601. Yeomans Brothers Co

Mechanical transmission systems

139 **Drive catalog** has 24 pp, gives engineering data to aid selection and installation. Hp ratings, installation instructions are tabulated. Maurey Mfg Corp

140 **Variable speed drives** with multiple-groove variable pitch sheaves are topic of 32-p catalog MVP-101-A. Drive tables are given. Browning Mfg Co

141 **Timing-drive-selection** bulletin gives 5-step method to select drive. Bulletin 21103 has 8 pp. T B Wood's Sons Co

142 **Packaged bearings** run on hydrodynamic oil film, described in brochure. Tann Bearing Co

143 **Friction clutch** controls torque, dissipates heat through cast-iron hub-and-pressure plate to combat

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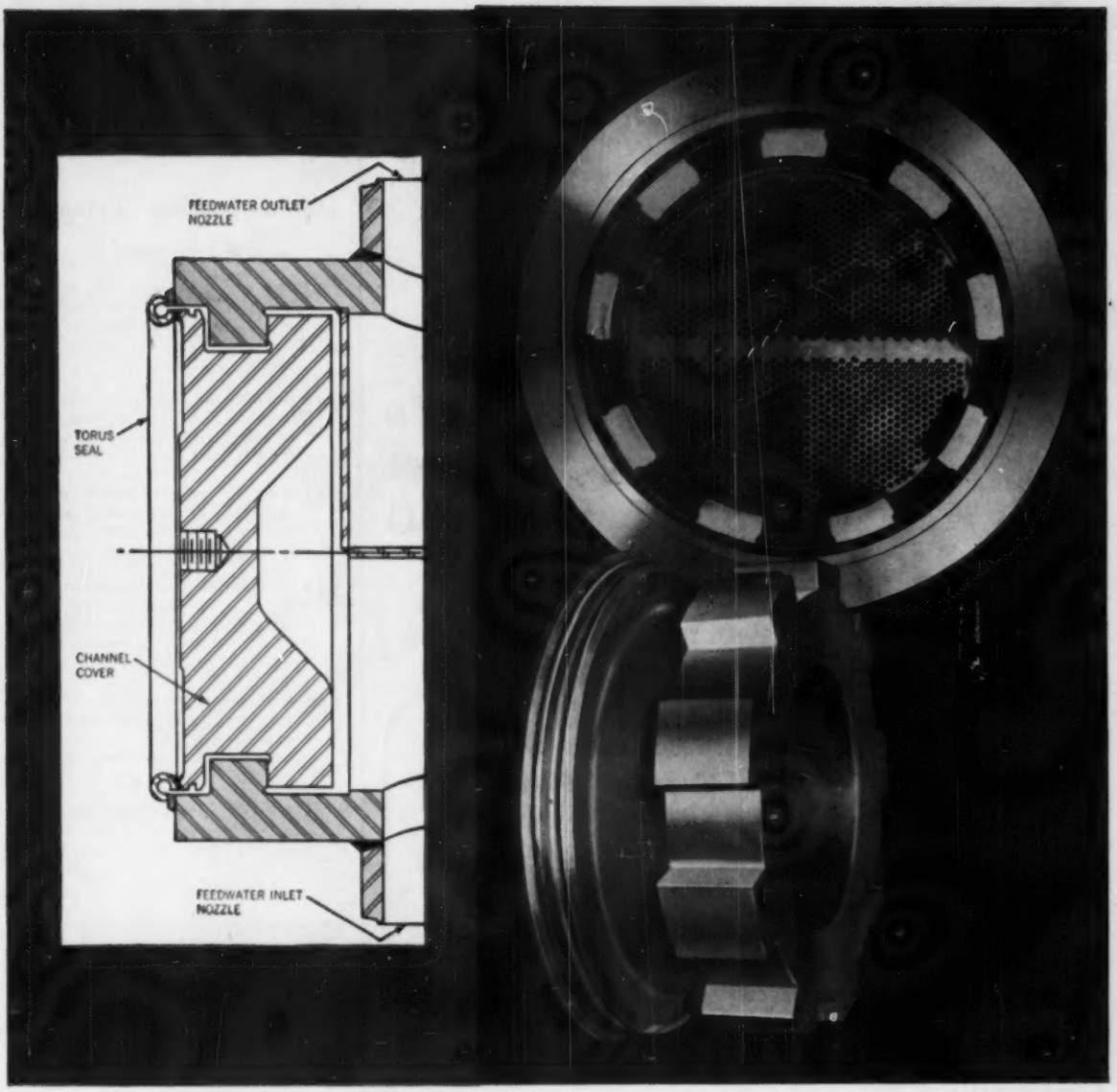

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This new closure combines quick-opening convenience with an all-welded seal that is *gasketless*. It is leakproof under the most severe thermal shocks. Yet the pressure cover can be removed quickly with simple tools.

The new Breech-Lockhead closure consists of two parts: (1) a pressure cover that resists the hydrostatic pressure by means of interlocking lugs on the cover and channel, and (2) a torus seal consisting of a partial torus welded to the edges of the channel and cover by a simplified welding procedure.

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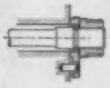

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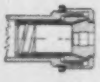

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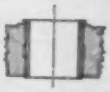
SPLINED SHAFTS & HEAVILY LOADED GEARS
Reduces fretting and wear. Also used for wearing in heavily loaded gears.



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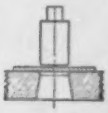
Prevents galling, seizing, metal pick-up and distortion.



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Makes difficult jobs easy and increases die life. Effective on punching and stamping tools.

SPHERICAL SEATS
Effective on spherical seats, rod end bearings, universal joints or wherever reciprocating motion exists.

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Free literature

Begins on page 104

distortion. Details are in bulletin available from Vickery Div of Norwalk Tool and Die Inc

Liquid-handling systems

- **Water treatment**

144 **Water, resin tests** are included in combination ion-exchange-resin-comparator chart and price list available from General Ionics Corp

145 **Single-tank sewage** treatment is topic of brochure 7315 describing combined five operations of unit. Dorr-Oliver Inc

146 **Nuclear, atomic-power-reactor** water-conditioning equipment is covered in bulletin NP-60. Hungerford & Terry, Inc

147 **Condensate scavenging systems** in high-pressure power plants are featured in technical reprint T-181 and bulletin Wc-128. Graver Water Conditioning Co

148 **Demineralizers,** mixed, two and four bed, are presented in 36-p catalog 160. Firm's complete line is covered. Barnstead Still & Sterilizer Co

149 **Water-treatment instrumentation** is topic of bulletin B96-2. Minneapolis-Honeywell Regulator Co

- **Pumps**

150 **Centrifugal pumps** with canned stator and flow-through rotor impeller are detailed in 4-p catalog M-60. The Corley Co, Inc

151 **Cost of electrical pumping,** methods for testing pumps, deep-well surveying are explained in 20-p manual Em-77. Peerless Pump, Hydrodynamics Div

- **Valves and gages**

152 **Free-discharge valve** for under 200-ft head is announced in 16-p well-illustrated bulletin O2B9206. Allis Chalmers Mfg Co

153 **Magnetic-gage catalog** 388 covers features, construction data, operation. Liquid-level gages are for use where glass cannot be tolerated. Details are available from Jerguson Gage & Valve Co

Steam systems

154 **Steam traps,** temperature regulators are featured in condensed 10-p catalog. Charts and tables aid selection. Sarco, Inc

155 **Steam-purity measurement** is topic of water-conditioning data sheet. New approach is introduced. Betz Laboratories, Inc

continued

For more facts circle 255 on Reader Service card, p 103 circle 256 on Reader Service card, p 103 ➤

New from WARNER AUTOMOTIVE...

Crane uses Warner muscle for valve operator that gives one man the strength of four:

The new Crane Converto-Gear® Valve Operator eliminates need for heavy tools, thus saves time and labor in opening and closing large valves in steam plants, refineries and other type processing plants. Its "muscle" is a Warner Gear Box Actuator with 4:1 mechanical advantage . . . weatherproof, self-lubricated, capable of withstanding heavy impact blows. Carburized and hardened automotive-type spiral bevel gears made from alloy steel forgings, supported by anti-friction bearings and mounted in grey iron housing, insure a long and useful life.

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B-W

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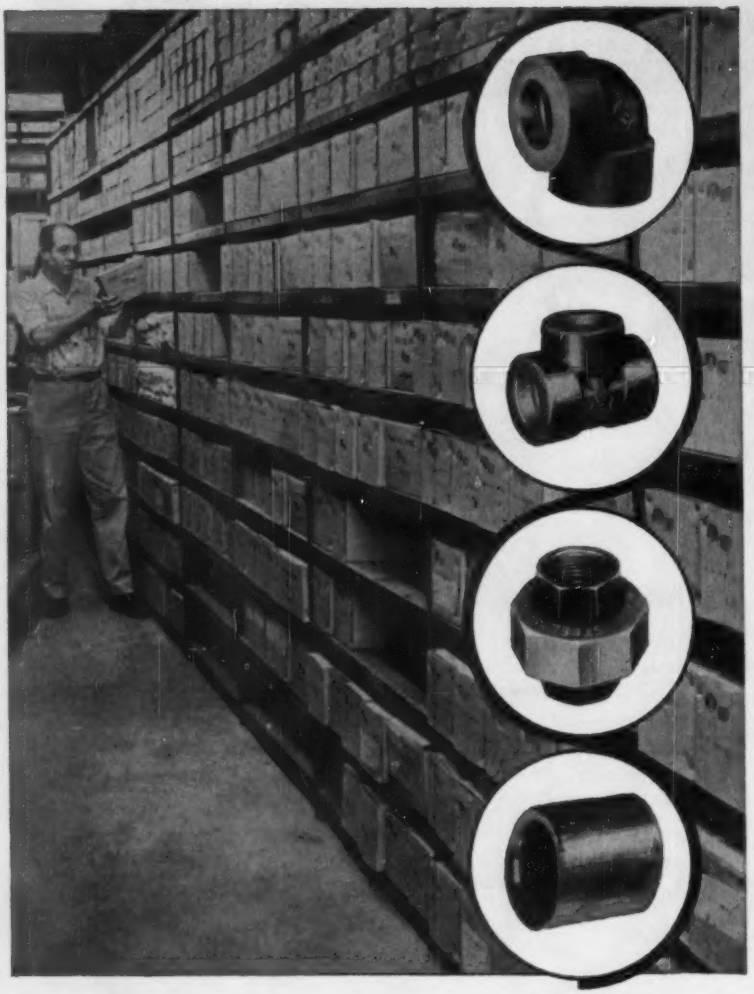

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While we're on the subject of inventories, we'd like to mention our packaging. Practically all types and sizes of fittings in any "mix" can be packed in a convenient W-S Case or Half-case . . . each type and size in its own carton.

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For more facts circle 257 on Reader Service card, p 103

Free literature

Begins on page 104

• Boilers

156 **Packaged water-tube boilers** are described in 4-p bulletin Ad-186. Cleaver-Brooks Company

157 **Scotch marine steam boiler plants,** automatic 3-pass design, are explained with charted specs and dimensions in bulletin A-104-3. Eclipse Boiler Div

158 **Forced-draft packaged boilers,** Scotch type, for high- and low-pressure applications are listed in 12-p brochure 149D from American-Standard Industrial Div

159 **Boiler-blowdown control,** electronically automated, is described in brochure. Unit's external and internal views are pictured. Boilertrol Corp

• Fuel handling

160 **Vibrating feeders** incorporating new principle of vibration are described in 6-p folder 2770. Link-Belt Company

161 **Crushing** handbook has 40 pp, discusses impact-, attrition-, shear- and pressure-reduction methods. Closed-circuit crushing systems are covered. Diagrams and charts are included. Pennsylvania Crusher Div of Bath Iron Works Corp

162 **Deep-trough belt-conveyor idlers** are topic of 8-p book 2716A which supplements book 2716. Selection data on 60 35-deg deep-trough idlers, additions to 45-deg-idler line are covered. Link-Belt Co

163 **Screw-conveyor drive** is subject of 4-p folder 2718. Sizes for screw diameters, selection data are listed. Link-Belt Company

164 **Crushers,** complete line, are covered in bulletin 4020. Applications of each type are explained. Pennsylvania Crusher Div of Bath Iron Works Corp

Electrical systems

• Generation and transformation

165 **Generating systems** in 10- to 200-kw range are topic of 8-p bulletin P-1. Standby generating sets are covered. Consolidated Diesel Electric Corp, Power Equipment Div

166 **Brushless** 400-cycle synchronous motor-generators are covered in 2-p brochure available from Leach Corp, Inlet Div

167 **Generator rated 1000-w** average and 2000-w peak power at 38 to 42 kc is described in data sheet. National Ultrasonic Corp

continued

Long grate bars with closely fitting overlay joints prevent leakages. Venturi air openings are spaced to provide uniform air distribution.

GRATES ARE THE GUTS OF A STOKER ——— DETROIT ROTOGRATE HAS PLENTY OF INTESTINAL FORTITUDE

No matter what else it has, no stoker can be a complete success without trouble free efficient grates.

The Detroit RotoGrate Stoker has other outstanding features in abundance but without the superior grate design it could never have achieved such instant and lasting success.

The advent of the RotoGrate Stoker established a whole new trend in coal firing and stimulated many competitors but none has seriously challenged the superior performance and long life of the RotoGrate.

Our grates are high resistance metering type with venturi air openings spaced to provide uniform air distribution. Long grate bars have close fitting overlay joints to prevent leakages that cause blow holes and burnouts.

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Guide chains riding over toothed sprockets assure positive grate bar alignment. A unique method of attachment avoids chain wear and stretching, while the catenary take up of slack prevents jamming.

Forward travel continuously discharges ash. Automatic combustion control varies the speed of travel in step with fuel feed rate to maintain uniform fuel bed while following fluctuations in load.

Burns all grades of bituminous and lignite coals, also many kinds of refuse and by-product wastes.

The RotoGrate for boilers to 400,000 pounds steam per hour capacity; other Detroit Stokers for capacities from 3,000 pounds steam per hour.

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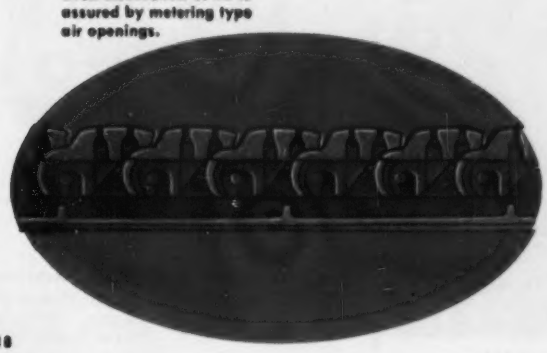
Cost equals initial investment plus upkeep plus production losses due to equipment outage. The total is less with Detroit.

Even distribution of air is assured by metering type air openings.



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More than a thousand Borg-Warner Type "D" Mechanical Seals are installed for high pressure, high temperature applications, and are proving their worth with phenomenal performance records —many operating well over three years in continuous boiler feed pump service!

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BW **Borg-Warner Mechanical Seals**

P.O. Box 2017, Terminal Annex, Los Angeles 54, California

For more facts circle 274 on Reader Service card, p 103

Free literature

Begins on page 104

168 **Power transformers** are described and illustrated in 44-p bulletin P-560. Design features, construction details, both internal and external, are given. Manufacturing process is described. McGraw-Edison Co, Pennsylvania Transformer Div

169 **Transformers** rated 112½ to 2500 kva for distribution equipment, firm's complete line, are described and illustrated in 8-p booklet GEA-6832A. General Electric Company

170 **Dry type transformers** rated 3 to 50 kva, single phase, are outlined in 4-p brochure 61B8232B available from Allis-Chalmers Mfg Co

171 **Current transformers** for metering are topic of 4-p bulletin 3-1.2. 200 types are listed. Associated Research, Inc

● **Distribution and protection**

172 **Oil circuit breakers** with 23-, 34.5-, 46- and 69-kv ratings are covered with drawings and photos in 16-p bulletin 7213. Federal Pacific Electric Co

173 **High-frequency bus duct** is featured in 12-p booklet 30-663. Application data, drawings, dimensions, specs are covered. Westinghouse Electric Corp

174 **Metal-clad switchgear,** 4160-v, is topic of 20-p brochure 2501-2A. Indoor, outdoor and walk in types are described. Design, construction and performance features are explained. I-T-E Circuit Breaker Co

175 **Electromagnetic - control** catalog 57 S covers mechanically- and magnetically-held transfer switches, battery chargers. Automatic Switch Co

176 **Subminiature force control** switch, tensile and compression types, are outlined in 4-p bulletin. Prices and engineering data are included. W C Dillon & Co, Inc

177 **Rollout switch** and fuse equipment are described in 8-p brochure GEA-6623B. General Electric Company

178 **Die-cast-aluminum conduit** made in both copper-free and copper-bearing aluminum are outlined in bulletins 657,658. The Pyle-National Company

179 **Conduiets** for corrosive locations is title of 20-p bulletin 2609. Corrosive substances are listed in tabular form. Crouse-Hinds Co

continued

one p-k scalefree 230* used for—

1 - supplying all domestic hot water
2 - for baseboard radiant heating
3 - for reheat in air conditioning system

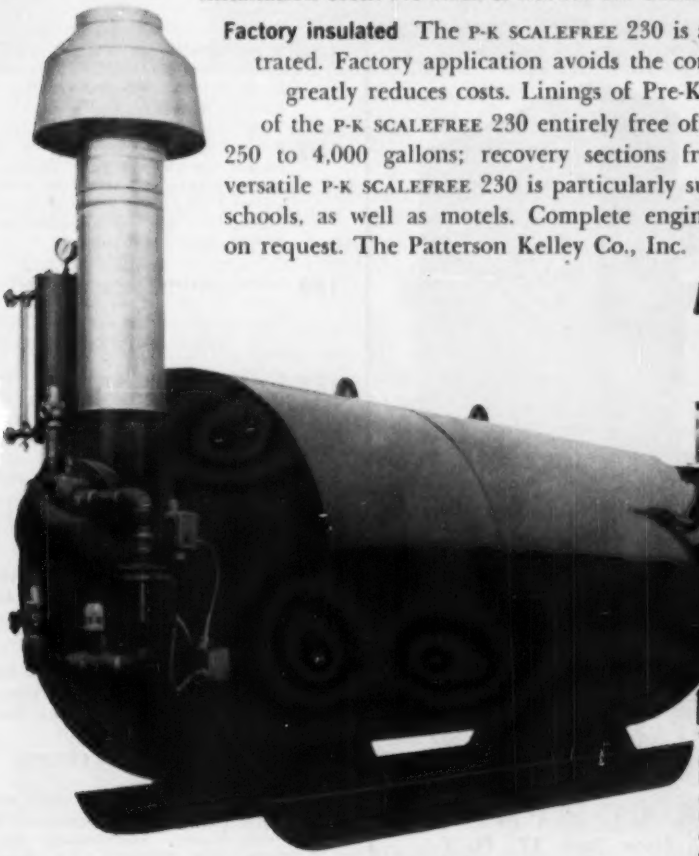
To supply all the hot water required for domestic service, baseboard heating, and reheat in air conditioning system, owners of the handsome Carousel Motel and Restaurant selected the new P-K SCALEFREE 230 . . . the industry's first indirect gas fired storage water heater. » » » High among reasons for choosing the P-K SCALEFREE 230 — It won't scale, and retains its rated efficiency, because heat transfer occurs below the temperature at which scaling minerals precipitate.

Quickly installed A complete and automatic package, the P-K SCALEFREE 230 can be skidded into place, hooked up and checked out quickly. There is no complicated piping or electrical work to run up installation costs. No stack is needed for extra draft. No foundation is necessary.

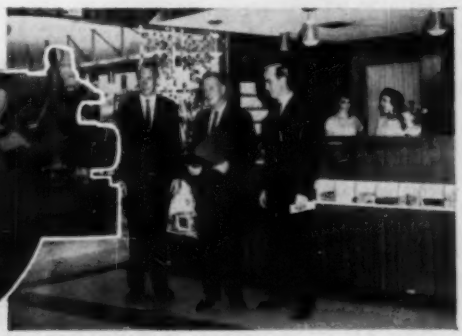
Factory insulated The P-K SCALEFREE 230 is available with factory insulation as illustrated. Factory application avoids the complications of on-the-site insulating and greatly reduces costs. Linings of Pre-Krete® or copper keep the storage section of the P-K SCALEFREE 230 entirely free of corrosion. Storage capacities range from 250 to 4,000 gallons; recovery sections from 390,000 to 2,215,000 B.T.U. The versatile P-K SCALEFREE 230 is particularly suited to office buildings, institutions and schools, as well as motels. Complete engineering and performance data available on request. The Patterson Kelley Co., Inc.

Patterson Kelley

Water Heater Division
104 Morgan Avenue, East Stroudsburg, Pa.



Heating-Air Conditioning Contractor, Kingston Electric Co., Kingston, Pa.



The Carousel Motel and Restaurant, with a capacity of 600 persons, recently opened at Wilkes-Barre, Pa., is owned by William Heck, William Heck, Jr., and Thomas Heck. They chose the P-K SCALEFREE 230 because it offered ideal performance and economy features for a service business such as theirs. The Pre-Krete lined unit has a storage capacity of 500 gallons, and a recovery rate of 325 gallons per hour from 40°F to 140°F.

*Patent pending

More equipment manufacturers choose Fast's Couplings than any other gear-type coupling

Leaving other claims aside, the thing that counts in couplings is customer confidence—and industrial equipment manufacturers have made Fast's their overwhelming choice. The Fast's line is more diversified, too—in a complete range of sizes and types for shafts, from ½" to 32" and larger.

Every Fast's Coupling brings you superb engineering only the original gear-type coupling can deliver. Smooth-running units that are designed to outlast the machines they connect. Rapid service from experienced field engineers backed by outstanding stock facilities. Write today for full details on couplings to suit your needs to: KOPPERS COMPANY, INC., Fast's Coupling Dept., 1111 Scott St., Baltimore 3, Maryland.

KOPPERS

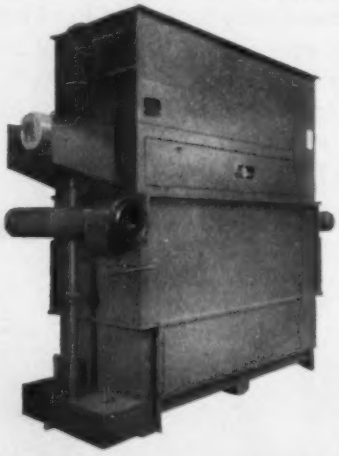
FAST'S COUPLINGS

Engineered Products Sold with Service

For more facts circle 261 on Reader Service card, p 103

How to get drier or cooler AIR or GASES

at low cost



NIAGARA *AERO* AFTER COOLER cools a compressed gas, or air, below the temperature of the surrounding atmosphere, thus preventing the condensation of moisture in your lines. The gas will contain only half of the moisture left in it by conventional methods. Even drier gas can be produced if you require it.

In working with controlled atmospheres of inert gases to prevent undesired reactions, this dryness of the gas at low cost is a great advantage. The cost of the Niagara method is low because it uses evaporative cooling, saving 95% of the cost of cooling water (and its piping and pumping). This direct saving of cost pays for the Niagara cooler in less than two years.

If you use compressed air to operate instruments or pneumatic equipment you will get better results by using the Niagara Aero After Cooler.

Write for Bulletin 130, or ask nearest Niagara Engineer if you have a problem involving the industrial use of air.

NIAGARA BLOWER COMPANY

Dept. P-11, 405 Lexington Ave., New York 17, N. Y.

Niagara District Engineers in Principal Cities of U. S. and Canada

For more facts circle 262 on Reader Service card, p 103

Free literature

Begins on page 104

● **Application**

180 **Stepping synchronous motors** are discussed in 4-p folder available from The Superior Electric Co

181 **Pumpmotors** brochure contains collection of reprinted technical articles. Lubrication, protection of pumpmotors are covered. U.S. Electrical Motors Inc

182 **Geared speed reducers** shaft-mounted, are featured in booklet F-2003. Illustrations, specs included. U.S. Electrical Motors Inc

183 **Electric-motor** book has 14 pp, gives data for selection and specification. Doerr Electric Corp

184 **Synchronous motors,** pedestal bearing, heavy duty type at 600 hp and larger, are covered in publication 1100-PRD-253. Electric Machinery Mfg Company

185 **Explosionproof synchronous** motors especially for hazardous areas are outlined in 8-p bulletin. Ratings and specs are charted. The Superior Electric Company

186 **Electric-motor insulation** is featured in 4-p booklet available from Crocker-Wheeler Plant of Elliott Company

187 **Motor-controls** catalog 60 is pocket size, has 56 pp of descriptions, ratings and prices for manual and magnetic starters, drum controllers and limit switches. Furnas Electric Company

188 **Speed variator** uses thyratron tubes to convert ac to dc power. Details are in 8-p booklet GEA-7019. General Electric Company

189 **Silicone-rubber protection** for form-wound motor windings, 150 hp and up, is detailed in bulletin F-1995. U.S. Electrical Motors Inc

190 **Integral-hp motor** brochure covers manufacturing process. Story is in well-illustrated bulletin PB6000-10. Elliott Co

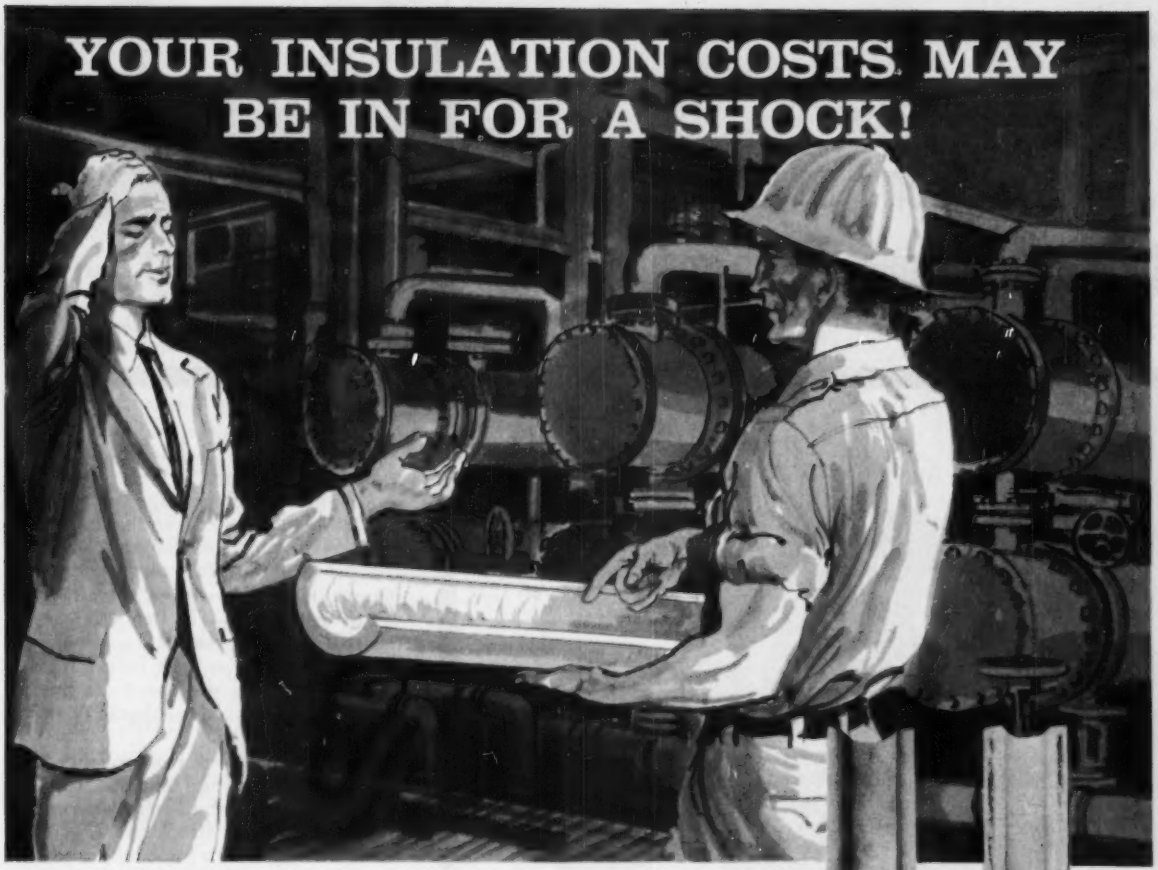
191 **Secondary batteries,** physical, electrical applications characteristics are explained in 10-p brochure. Yardney Electric Corp

192 **Motor selection** guide is pocket size card, provides quick reference. General Electric Company

Air-conditioning systems

193 **Packaged air conditioners** are featured in 12-p bulletin 8825. Performance, engineering features are covered. American-Standard Industrial Div

YOUR INSULATION COSTS MAY BE IN FOR A SHOCK!



use Unibestos to eliminate thermal shock effects

Insulation that looks perfectly intact on the outside is sometimes a maze of cracks on the inside. That's when your operating costs, in the form of *heat losses*, begin sailing off into thin air. And it's thermal shock effects like this that can put the real shocker on your operating costs.

But you won't find thermal shock effects in any section of Unibestos insulation. Unibestos defies thermal shock, fumes, acids and moisture; resists impact and rough handling; eliminates shrinkage; cuts application time and costs; and guarantees real insulating efficiency. That's why it's worth more. Yet it continues to sell at competitive prices.

Available in full range of standard pipe sizes and thicknesses. Single thicknesses to five inches. Specials to 44" O.D. in half sections.

Write today, on your letterhead, for Bulletin No. 65610.

UNIBESTOS AMOSITE INSULATION 900° F.

EFFECTS OF THERMAL SHOCK

Exclusive use of extra long *Amosite* asbestos is your positive assurance that Unibestos insulation has the mechanical qualities that prevent thermal shock effects. Guaranteed up to 1200° F, Unibestos has been known to withstand temperatures as high as 2000° F, without thermal shock effects.

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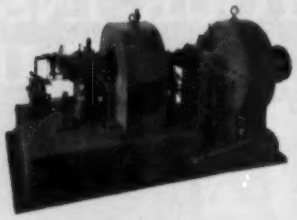
• UNIBESTOS, Amosite Asbestos Pipe Covering and Block • Calcium Silicate Pipe Covering and Block • 85% Magnesia Pipe Covering and Block • Mineral Fiber Block • Wrap-On Insulation • Lace-On Insulation • Turbine Blankets • Insulating and Finishing Cements • Asbestos Textiles • Packing and Gasketing.

UNION ASBESTOS AND RUBBER COMPANY • FIBROUS PRODUCTS DIVISION

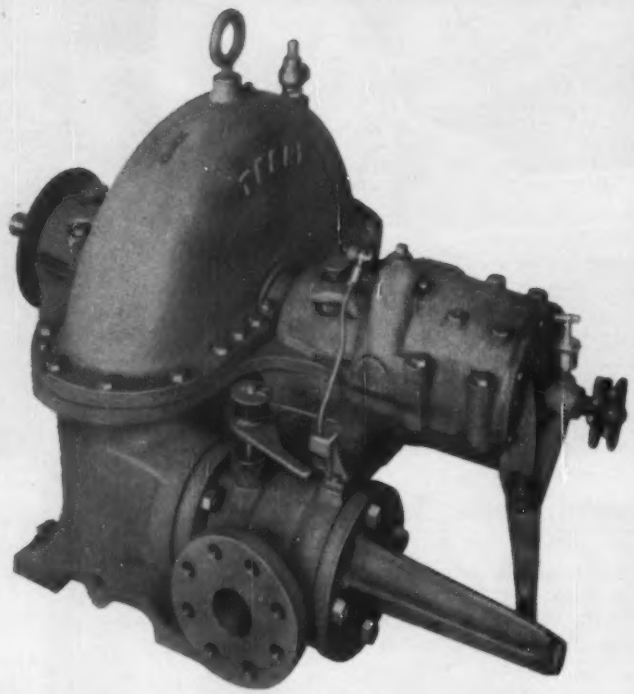
DEPT. 218, Bloomington, Illinois

For more facts circle 263 on Reader Service card, p 103

There's a Terry solid-wheel turbine for any mechanical-drive requirement



Solid-wheel turbo-geared unit rated 600 hp, 4000/650 rpm.



Standard solid-wheel turbine with constant-speed mechanical-type governor and hand speed changer.

The completeness of the Terry line of solid-wheel turbines enables you to choose an *ideal* drive for any application . . . choose the specific features you want from a wide variety of designs.

Standard turbines are made in capacities up to 2,500 hp, with either cast-iron or cast-steel casings. The standard wheel is carbon steel. Where operation is to be at high speed or at high temperature, wheels of forged alloy steel are used. Vertical and geared turbines are also available.

And you can select from a range of governors, including: constant speed, either mechanical or oil relay, and variable speed, either direct acting or oil relay. Excess-pressure or constant-pressure pump governors are also available. When required, remote speed control can be furnished for variable-speed governors.

Tell us what your requirements are so we can send you full details of a turbine to meet your needs exactly. For general information, send for a copy of bulletin S-116.

THE TERRY STEAM TURBINE COMPANY
TERRY SQUARE, HARTFORD 1, CONN.

TERRY

Vertical turbines with the Terry solid wheel are available in capacities from 5 to 300 hp.

TT-1218

Hall Industrial Water Report

VOLUME 8 NOVEMBER 1960 NUMBER 6

Pouring Oil on Water

Oil will quiet angry waters. But when oil is inadvertently introduced to boiler feedwater it can cause plenty of trouble with blistered tubes and carryover. Other contaminants in makeup water or condensate can be equally or even more dangerous. Thus, for good boiler operation it is essential to keep boiler feedwater free of significant quantities of contaminating materials.

It is part of the Hall engineer's job to help you locate possible sources of contamination before difficulty occurs. When, in spite of all precautions, something troublesome does get into the boiler feedwater, he is prepared by his training and experience to help you to locate the source quickly. He is also prepared to be of service on all your water problems whether they be in the boiler house, in process, in cooling systems or in waste disposal.

Silica Trouble

An unusual condition caused production losses in an Eastern paper mill. Makeup water for the high-pressure boiler was clarified with aluminum sulfate and activated silica and then deionized. When upsets occurred in the clarifier, colloidal silica passed through the deionizer and into the boiler. This resulted in high boiler water silica concentration, which necessitated boiler operation at lower than normal load. Hence, loss of production.

Hall engineers studied clarifier operation by means of numerous jar tests. These showed that substituting a non-siliceous Hagan coagulant aid for activated silica would produce satisfactorily clear water with complete elimination of silica carryover. A bonus was a more than twenty percent increase in anion exchanger capacity due to the decrease in the silica content of the clarified water.

Tracing Condensate Contamination

Foaming of the boiler water at a midwest manufacturing plant indicated that contamination of feedwater was occurring. A further indication of contamination was difficulty in testing—when an alkaline oxidizing reagent was added to samples for oxidation of organic matter in the phosphate test, the water turned black.

The condition in the phosphate test was checked by Hall field engineer Earl Hoehn. He discovered that he got the same black color when he added the reagent to some condensate samples. He then used this unusual but timely test to trace the contamination to its source. It turned out to be nickel plating and metal cleaning solutions, which were getting into the condensate through small leaks in the steam heating coils in the solution tanks. The reaction between the nickel and the alkaline oxidant was producing black nickelic hydroxide.

Boiler Cleaning Problem

Many of the compressors and pumps in a New York State hospital are driven by reciprocating engines. The oily exhaust steam is used for space heating and heating hot water. The condensate is then returned to the boilers.

Because of the lack of oil removal equipment there is so much oil returned to the boilers at times that some can be seen floating on boiler water samples. Oily sludge accumulates and boiler cleaning is a real problem. A turbine quickly becomes fouled so badly it is valueless. The only effective procedure the operating men discovered was swabbing out the tubes with rags soaked in a solvent.

When Hall field engineer Sam Dilcer learned about the problem he tried boiling out the boilers with a strongly alkaline metaphosphate-metasilicate (Calgonite) solution. This is usually effective but in this case the amount of oil in the sludge deposits was so great the boilers remained dirty. Wire brushing was necessary and the wire brushes became fouled so rapidly they had to be rinsed in a solvent after passing through one tube.

Dilcer then recommended boiling out with Calgonite plus a cleaner of the emulsified hydrocarbon type (Calgon Emulsion Cleaner). This left nothing to be desired. Wire brushes drawn through the tubes remained clean. The plant engineer told Dilcer, "You licked our problem with the boilers so we'll have to find something else to keep you busy."

New Booklet Available

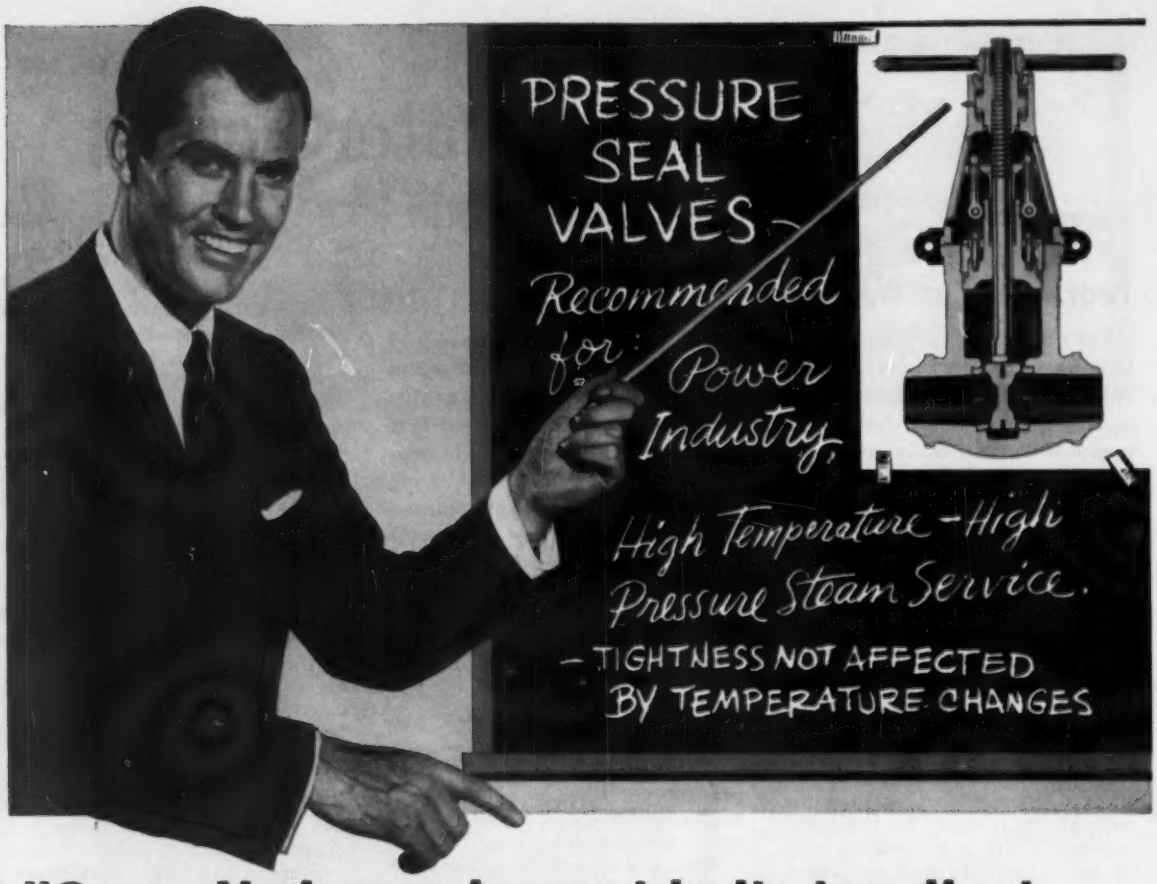
A new 24-page booklet describes the many ways industry can use Hall Laboratories industrial water consulting services.

For your copy, write on your letterhead to:

HALL LABORATORIES
HAGAN CENTER, PITTSBURGH 30, PA.
Consultants on Procurement, Treatment, Use and Disposal of Industrial Water

DIVISION OF **HAGAN** CHEMICALS & CONTROLS, INC.

For more facts circle 265 on Reader Service card, p 103



"See...No heavy bonnet bolts to adjust on R-P&C Pressure Seal Valves"

"The R-P&C Pressure Seal Valve pictured here is an outstanding example of a modern valve designed for modern service. Built to give **absolute tightness** under high temperature, high pressure conditions, it has **no heavy bonnet bolts** to adjust. Instead, bonnet bolts and flanges are replaced by a pressure seal bonnet joint which completely eliminates leakage even when pressure and temperature are reduced during a line shutdown. Moreover, the bonnet joint on this valve may be removed and reassembled with greater ease than a conventional bolted bonnet."

Notice, too, that this valve has a **compensating type wedge** which adjusts for tight closure and overcomes sticking or jamming when wedge is seated.

Castings for all pressure seal valves are produced in R-P&C's own steel foundry and are subject to critical internal examination by our own Radiographic X-ray equipment.

R-P&C Pressure Seal Valves are available through 14" size in Gate Valves and through 8" size in Globe and Lift Check Valves. All are available in the 900-1500 and 2500 pound classes.

For complete details about pressure seal valves or any valve in the R-P&C line, **consult your R-P&C distributor.**

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ACCO

R-P&C Valve Division, American Chain & Cable Company, Inc.

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For more facts circle 266 on Reader Service card, p 103

MAIN STEAM

(20" OD x 2.250" min. wall A335 P-22)

HOT REHEAT

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BOILER FEED

(10¾" OD x .593" avg. wall A335 P-11)

EXTRACTION LINES

(6⅝" OD x .280" avg. wall A335 P-11)

FIELD ERECTION PIPING

(½" IPS XXH A335 P-22)

Nothing too LARGE
. . . or too SMALL

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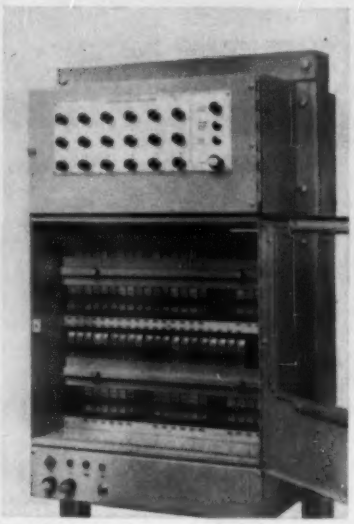
For more facts circle 267 on Reader Service card, p 103

For more data on these developments, circle key numbers on Reader Service card, p 103

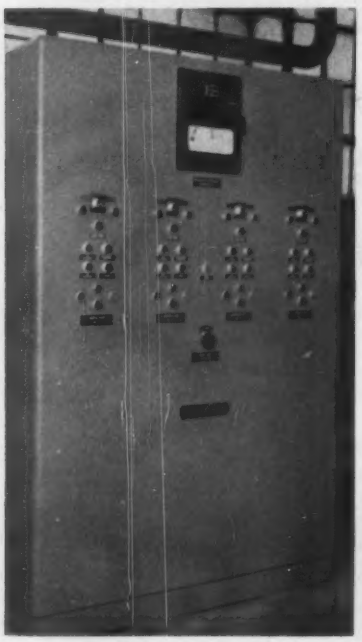
Plant equipment news . . . Your

Scanning system lets subs go unattended, functions electronically using no relays



1 • Pure electronic system monitors, controls alarm and remote station on-off functions from central station—lets power substations, pumping plants, pipeline installations and similar installations go completely unattended. Using solid-state circuitry throughout, unit uses no relays, stepping switches, motor-driven commutators or rotating switches. Time-division multiplexing codes each function—go-no-go, start-stop, on-off. Unit is capable of scanning and controlling up to 36 separate functions in 40 milliseconds—can be set to operate on a predetermined basis for one or more functions in any order desired. A transistor user, unit is pint size but speedy.—Lynch Communication Systems Inc

Panel is control point for five compressors



2 • Multiunit, automatic control panel will take on as many as five electric-motor-driven compressors. Panel lets you control all compressors at once or any one in the group manually or fully automatically. Electric control devices are designed to keep operating only machines required for immediate demands of process air or gas operation.

In automatic operation, no two machines can start at the same time; each preceding unit must be running before next can start. Sequence is set by manually-base-operated unit selector which starts up and shuts down compressors. Alternate selection of the base unit distributes even wear over all compressors in the system. Automatic shutdown devices can be tied into system to protect equipment.—Clark Bros Co

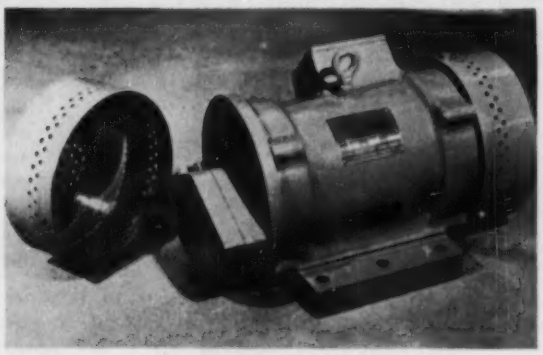
Data-acquisition system

3 • High-speed low-level differential system features versatile format control producing data acceptable for most computers. Modular design can accept all types of electrical signals representing different variables requiring measurement. Solid-state data reduction system processes both operating and test data.

System has three components: high-speed scanner in 10-channel multiples, high-speed analog-to-digital converter and output format control. Scanning and analog-to-digital conversion equipment accept low-level signals without preamplification. You can directly connect inputs such as thermocouples, strain gages, pressure, flow and level transducers and qualitative and quantitative analyzers. System features simplicity, is portable.—Electro Instruments, Inc

Circle key numbers on Reader Service card, p 103

information center for new products and materials



Rocking motor is hardy, versatile

4 • Electric motor for vibrating drives has heavy-duty bearings, robust shafts and out-of-balance weights at each end to generate vibration, give reliable performance, maker claims. You can use motor for withering tea leaves or driving high-speed vibrating screens. It dedusts small coal, debreezes coke, screens foundry sand, chemicals, etc. Totally enclosed dustproof and weatherproof, unit is nodular cast iron with integral feet. Output ranges from 200 lb at ⅛ hp to 8000 lb at ½ hp.—English Electric Export and Trading Company Ltd

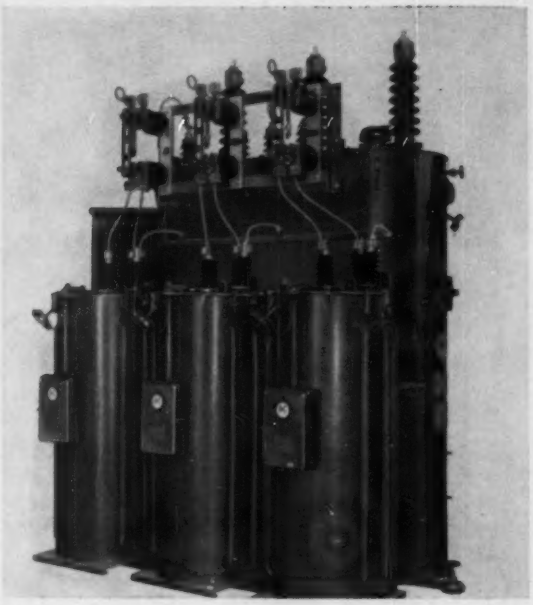
2 to 15-hp drives for synchronous induction motors

5 • Drives give adjustable speed running in exact synchronism over a wide range of speed. It has adjustable-frequency power supply, one or more synchronous induction-drive motors and a control panel. Ac alternator with mechanically adjustable speed gives adjustable frequency power.—The Louis Allis Co

Hairpin stab to use with low-impedance plug-in bus duct

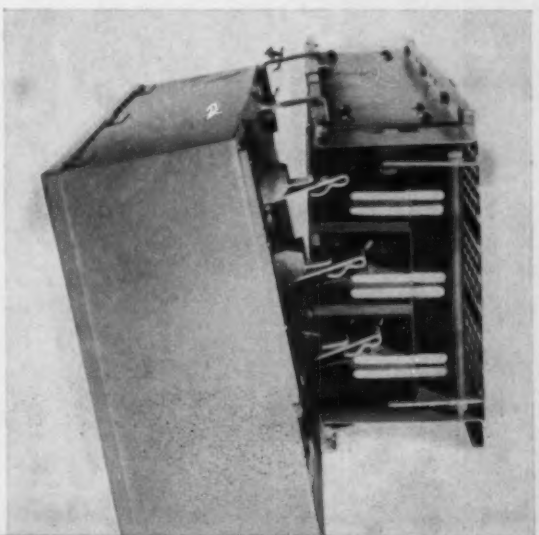
7 • Stab with inverted hairpin design is said to exert more than normal pressure when carrying heavy inrush or short-circuit currents. According to maker, stab exerts more than normal 60 lb pressure.

Rated to 400 amps continuously, unit has a variety of applications but is best for heavy duty. Install in all kinds of current take-off devices—safety switches, circuit breakers, plug-in cable tap boxes and panelboards which mount directly on the duct. Where resistance welders are used, stab design will take more than twice 16,000-amp inrush current. Manufactured in one size only—use three in each current take-off device, four when a neutral is involved. You can adapt this stab for vertical riser applications, maker says.—Federal Pacific Electric Co



Assembly cuts substation cost

6 • Simplified arrangement gives single-phase regulation with 3-phase unit assembly. Three single-phase regulators mount directly on 3-phase power transformer. Bypass switch is located above each regulator. Result is that space is saved—you only need one concrete pad for mounting the entire assembly. Assembly offers flexibility through single-phase regulation to subs having outgoing feeder which handles single-phase loads on all three phases. Bypass switches have visible disconnect permitting regulators to be safety bypassed for periodic inspection without interrupting transformers. —Allis-Chalmers Mfg Co



More **equipment news**

For more data on these developments, circle key numbers on Reader Service card, p 103

Axial-flow blowers handle 1000 to 500,000 cfm, fill many needs

8 • Complete line of units for heating, ventilating and air-conditioning industries has blading similar to jet-engine aircraft type. Sizes range from 12-in. dia in fixed-blade design to 12- to 120-in. dia in patented blade-retention design. Hub diameters come 14 to 40 in.

Engineered drives available for this equipment include belt, coupling or direct drive. Features are: reduced floor-space requirements, less noise, easy installation and long life with low maintenance, says manufacturer.—Benson Manufacturing Company

Furnace on wheels

9 • Indirect-fired portable space heater blows air around the outside of a completely enclosed combustion chamber, produces large volume of fresh air. Similar to an oil furnace, it produces 200,000-Btu heat at rate of 1600-cu-ft warm air per min, or 420,000 Btu at rate of 4500-cu-ft air. Fumes can be vented out of top for safety. You can attach ducts to pipe air for spot heating.—Stow Mfg Co

Versatile air-intake units

10 • Vertical discharge units for replacing air removed by exhausts feature versatility, says maker. With standard components, these units will do many kinds of jobs. Just add shutters, steam coil, filter house or diffusers to this blackout type roof-ventilator-fan housing.

Units have 4000- to 36,000-cfm, 380,000- to 2,642,000-Btu-per-hr range.—Hartzell Propeller Fan Co

Vibrator, speed regulator give joint efficiency

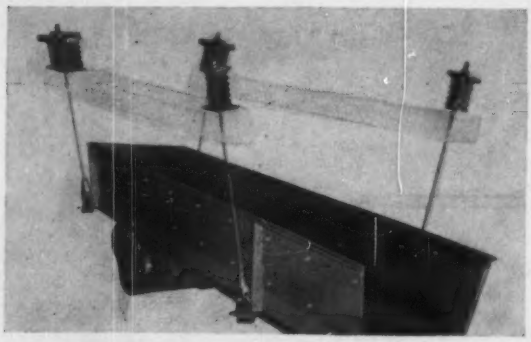
11 • Electric vibrator has companion speed-regulator unit for regulating both vibration frequency and impact intensity. Just a twist of a dial lets you vary vibration frequency from 1500 to 9000 vibrations per min, impact from 9 to 300 lb.

Built-in fuse prevents burnout from overloading or short circuiting. Speed regulator can be mounted in any position to suit your needs.—The Wellman Company

Flow switch guard for materials handling

12 • Flow switch keeps vigil on materials, corrects or warns of flow stoppage. When flow stops, switch is automatically actuated. It will start an electromagnetic bin vibrator or stop a vibratory feeder. When switch is the energizing agent, it becomes either an audible or manual alarm system. Rating; one amp, 115 v; .5 amp, 230 v.

You can use a number of switches located at critical points on one system.—Syntron Company

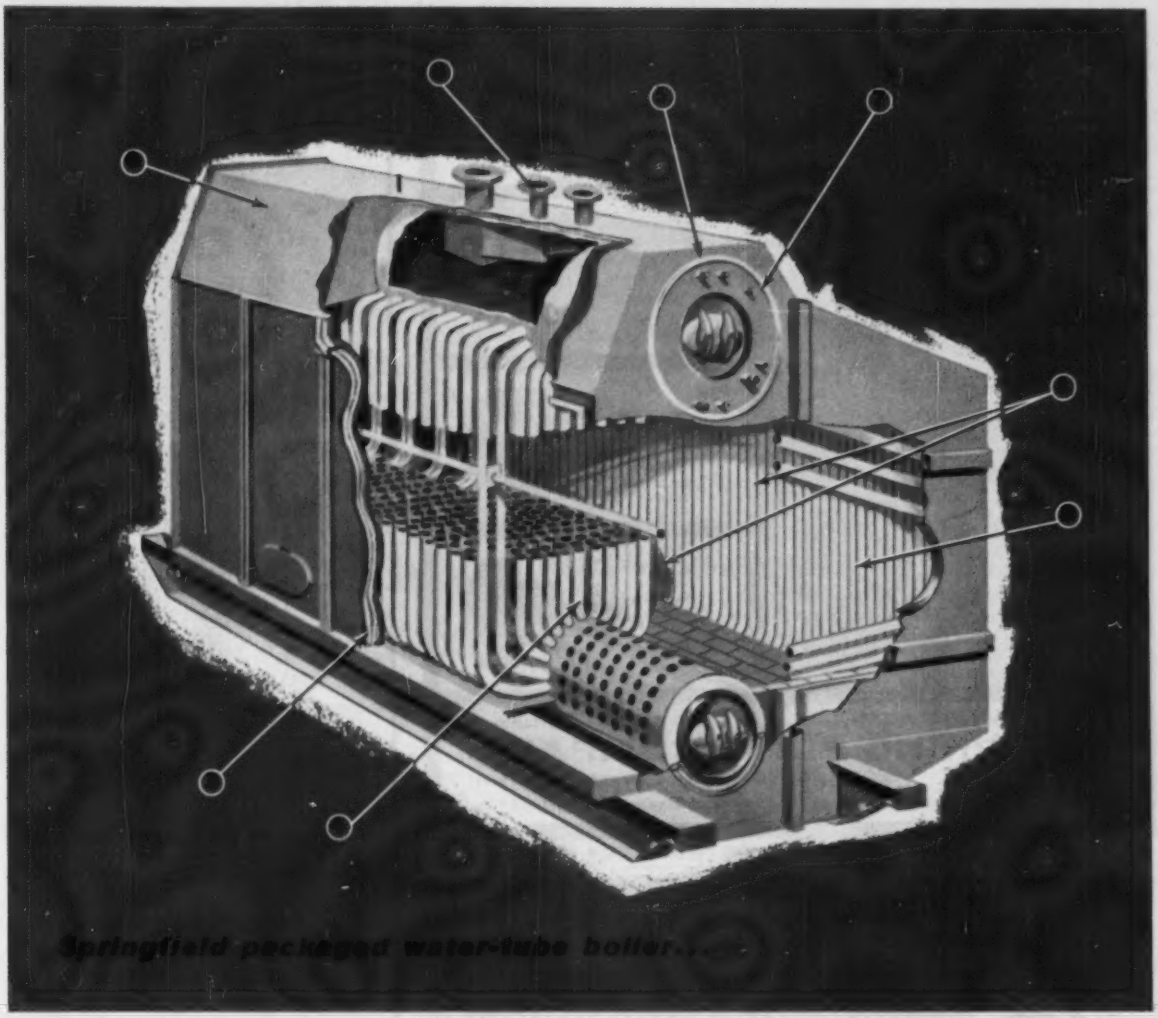


Unbalanced shafts rotate in opposite directions for vibration efficiency

13 • Vibrating feeders feature new vibration principle. Pancake motor mounted directly on vibrator frames drives two unbalanced shafts which rotate in opposite directions. This rotation causes the motors to synchronize and produce feeding motion despite absence of direct coupling between shafts. Effective feeding of any material results.

Thirty sizes are available with capacities up to 1350 tons per hr. All bearings, shafts are enclosed for protection against shock loads. Units can be cable suspended or floor mounted.—Link Belt Company continued

For more data on these developments, circle key numbers on Reader Service card, p 103



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2. **SIX-WALL FURNACE COOLING.** Water tubes on all surfaces — top, bottom and four sides — receive the heat. This keeps casing temperature down. A double row of tubes protects the rear wall of the furnace.
3. **INSULATED DOUBLE-STEEL CASING.** First applied on packaged boilers by Springfield, this double casing eliminates the need for refractory material in the side walls often necessary in other makes of boilers. Result — no refractory maintenance.
4. **MOST EFFECTIVE TUBE ARRANGEMENT.** Staggered tubes in the convection zone direct hot gases into a turbulent pattern for maximum heat transfer. Wide/narrow rows provide full accessibility to every water tube.
5. **UPPER DRUMHEADS FULLY INSULATED.** Another job-site expense item eliminated. Factory-applied casing covers drumheads. You avoid the cost of field-applied insulation.
6. **A MANWAY IN EVERY DRUMHEAD.** Springfield stresses operator safety with these extra manways for maintenance, inspection and cleaning — included at no extra cost to you.
7. **WELDED, GASTIGHT EXPANSION JOINTS.** Another Springfield original and exclusive feature. These unique, fully welded expansion joints absorb both horizontal and vertical expansion stresses — eliminate costly casing maintenance.
8. **UNIQUE STEAM SEPARATOR.** Developed by Springfield engineers for large central station boilers, then adapted for the "D" type boiler, this steam separator assures continuous dry steam for the life of the boiler.
9. **TOTAL BOILER SERVICE.** Your boiler investment is safeguarded by service that begins with advanced design and engineering, through factory testing, and carries through to factory-authorized starting service to assure you of maximum operating efficiency.
10. **TOTAL BOILER EXPERIENCE.** Springfield's 70 years of experience in the water-tube boiler field plus Cleaver-Brooks' leadership in the packaged fire-tube boiler field are back of every boiler produced, every recommendation made. You can contact Cleaver-Brooks, with confidence, for answers to *any* boiler problem.

We offer packaged water-tube boilers and field-erected units to meet your required capacities.

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For more facts circle 268 on Reader Service card, p 103

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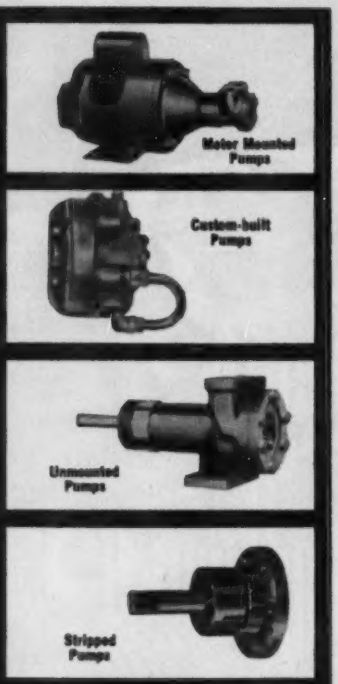
SPECIFY exact size and capacity needed—also materials of construction.

OPERATE pumps in either direction, including reversible operation.

DEVELOP pressures up to 500 lbs. (hydraulic oils), 200 lbs. (heavy duty), 100 lbs. (general purpose).



For complete information, ask for catalogs BW, CW and SP-509W

VIKING PUMP COMPANY

Cedar Falls, Iowa, U.S.A. In Canada, it's "ROTO-KING" Pumps

See Our Catalog in Sweet's Industrial Construction and Plant Engineer's Files

For more facts circle 269 on Reader Service card, p 103

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that will withstand 3000°F

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- AerOPak can be bent and weldments performed without loss of insulation.
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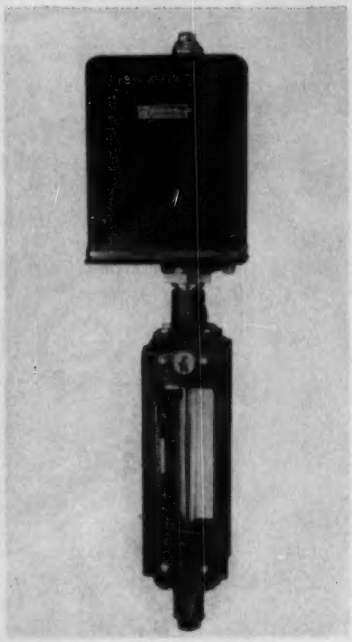
Equipment news

Begins on page 120



Rotameter measures fluid flow rate, acts as alarm

52 • Magnetic unit indicates abnormal high or low flows, activates warning light or alarm device, will start or stop a pump, motor or control unit. It uses a standard 5-in.-scale glass tube and a sensing system. Float extension rod with encapsulated magnet extends into stainless-steel housing tube which mounts switch assemblies. Switches activate high- or low-flow alarm or start-stop switch. Schutte and Koerting Company

Just circle key numbers on the Reader Service card, page 103, to get complete product story

Adjustable diameter bolts

62 • Units give exacting radial fits in all holes, are simple and economical, says maker. You can have any degree of tightness, compensation of wear with no pressing or careful matching of bolts to holes. Wall-thickness bushings permit bolts to slide easily into hole bore to be tightened to exacting degrees. Anyone can do it—there's no training involved.—Adjustable Bushing Co

continued

For more facts circle 270 on Reader Service card, p 103

A Nalco PRODUCT MANAGER

Answers Basic Questions on Coagulation of Solids in Potable, Process and Waste Waters

New Chemicals and New Techniques Mark Advances in Solving A Frequent Plant Operating Problem

Improved methods of chemical clarification are constantly being developed, tested, and put into full-scale commercial use. Here are answers to some of the questions we hear frequently in this area of Nalco service activity.

Question: What is coagulation?

Answer: Coagulation is the agglomeration—chemical gathering together—of the very fine solid particles suspended in water. These particles create turbidity, coloring, and some types of odors.

Question: What are the advantages of coagulation over sedimentation?

Answer: Speed, more effective clarification, and smaller capital equipment investment are all advantages of coagulation over sedimentation.

Question: Are all coagulation requirements the same?

Answer: No. In some cases, a high degree of sparkling clarification is essential. In others, a lesser degree of clarification is satisfactory. Sometimes, the removal of color is the only job to be done. Seasonal and other changes in water and turbidity characteristics also change the type and amount of treating necessary. Overall quality of the water must be compatible with the end-use requirements—not based on a fixed "cure-all" treatment program.

Question: What are the characteristics of a good coagulation program?

Answer: Continuous production of water of the necessary clarity and quality to meet end-use requirements; with the flexibility to handle changing conditions in input water characteristics. A good coagulation program should also increase the length of filter runs.

Question: Historically, what coagulant chemicals have been used?

Answer: Most common chemicals used as coagulants were: iron salts, alum (aluminum sulfate), and lime (calcium hydroxide).

Question: What are some of the more recent improvements in the field of coagulation?

Answer: Sodium aluminate is probably the first of the "modern" coagulants. It supplies an alkaline source of alumina with a negative (anionic) charge, and constitutes a coagulant which ideally meets the requirements of principal coagulation process uses—frequently with alum, to improve flocing and give faster settling rates at lower overall costs.

Natural and synthetic organic polymers are the most recently-developed coagulant chemicals. They are high molecular weight materials which are anionic, cationic, or nonionic; and function as high-efficiency coagulant aids. Or, as is true with the cationic polyelectrolyte developed by Nalco, they may function as both coagulants and coagulant aids. Use of these materials provides greatly increased floc particle size and weight, resulting in increased clarity, longer filter runs, and increased throughput rates.

Question: Will any of these newer coagulant chemicals solve all clarification problems?

Answer: No. There is no all-purpose coagulant chemical; nor is there likely to be one. Too many variables enter into the choice of proper chemicals to fit specific operating conditions: from the type of influent water through kinds and arrangements of equipment to the clarity needs of effluent water.

J. T. Burke, Manager
Nalco Coagulation Chemicals Department

Question: What is the best approach to solving a specific coagulation problem?

Answer: Take all the factors involved, and accumulate specific information on them: (a) Make a thorough investigation of the supply water, the equipment employed, the end use of the water, and the performance characteristics of chemicals available for coagulation and coagulation aid. (b) Test coagulation with various chemicals by beaker tests and other laboratory evaluation techniques. Evaluation should include analysis of waters produced, to make certain that the quality is compatible with end-use requirements. (c) Get the advice and assistance of experts as to methods and locations of applying chemical treatments to get maximum coagulation efficiency.

Question: Does Nalco provide the experts to gather this information?

Answer: Yes—in addition Nalco supplies the most complete line of coagulants and coagulant aids in the industry.

Question: How is Nalco qualified to help solve coagulation problems?

Answer: Nalco's basic background is successful water treatment. The Coagulation Chemicals Department at Nalco is made up of "specialists' specialists": men whose sole job is to provide Nalco Representatives and their customers with the materials and assistance necessary to solve coagulation problems.

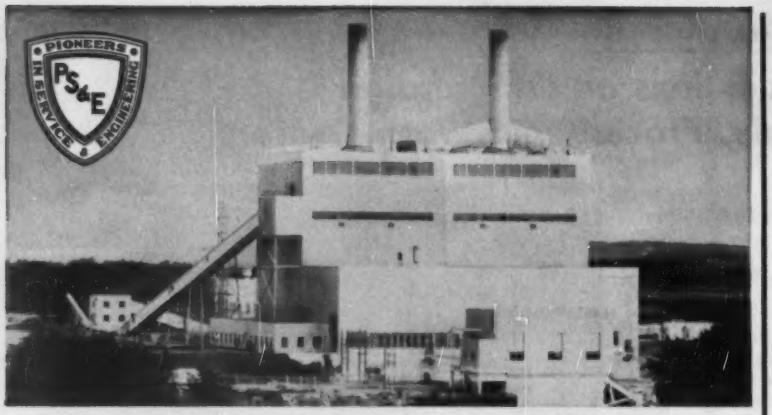
No other organization has more experience or better facilities to solve *your* coagulation problem, promptly and economically. Call or write for action now.

NALCO CHEMICAL COMPANY
6227 West 66th Place • Chicago 38, Illinois
Subsidiaries in England, Italy, Mexico, Spain, Venezuela and West Germany
In Canada—Alchem Limited, Burlington, Ontario

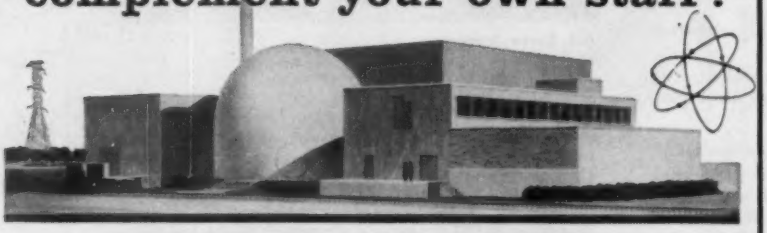
Nalco® ... Serving Industry through Practical Applied Science

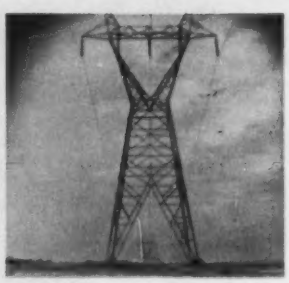
Nalco CHEMICALS
Nalco SERVICES

For more facts circle 271 on Reader Service card, p 103



Which Pioneer service do you need to complement your own staff?





DESIGN AND CONSULTING ENGINEERING SERVICES

Pioneer specializes in designing power plants and offers design service for fossil fuel, hydro and atomic plants. It will also assist in forecasting load growth, in site selection, in purchasing and expediting of equipment and construction management. Pioneer's other services include substation, transmission and distribution studies and design.

SERVICES IN REGULATORY MATTERS

Pioneer offers its services in all phases of Federal, State and local utility regulation, including natural gas and electric rate matters, certificate proceedings, licensed project accounting requirements, depreciation studies for rate case and income tax purposes, cost allocations and special studies.

CORPORATE SERVICES

Pioneer offers its services as business and management consultants; stock transfer and dividend disbursing agents; financial, accounting and tax consultants.

Write for Booklet "PIONEERING NEW HORIZONS IN POWER"

Serving Electric Utilities and Industrial Power Users Since 1902

Pioneer Service & Engineering Co.

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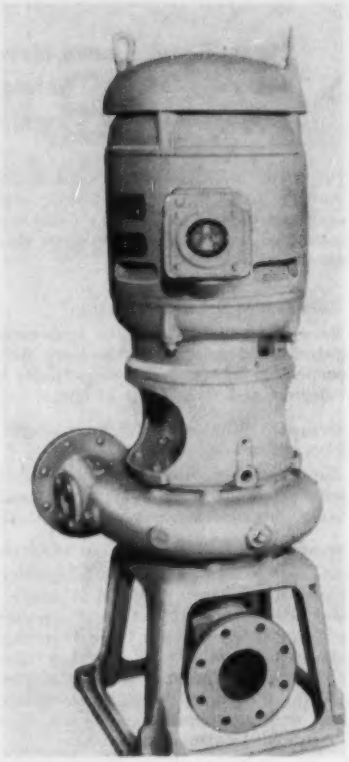
Equipment news

Begins on page 120



NEMA-matched centrifugal pumps

61 • Feature of this pump line is that pump dimensions align with those of NEMA-rated motors for easy mounting and installation, says maker. Designed to furnish a wide range of clear water, pump frames will receive various size volutes and impellers. Each individual pump becomes the equivalent of several individual units.

You can install without makeshift height-adjusting blocks and odd-bore couplings.—Fairbanks, Morse & Co

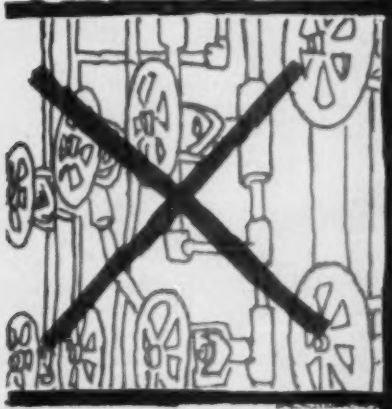
Just circle key numbers on the Reader Service card, page 103, to get complete product story

Solid urethanes come in roll, sheet, tube, cast parts

65 • New family of solid urethanes can be compounded to your specifications in rod and cast parts, sheet or tube to fill many requirements. According to maker, these urethanes

Only one way to go...

...That's to *automatic* valve operators. Manual valve operation is just too haphazard — not to mention expensive. And you can automate without a lot of costly down time, too. General Controls' famous



Tork-Master® electric gear-driven operators adapt to existing manual valves right in the field. Or, if you're considering replacement or new construction, it'll pay you to check into the Hydramotor®, Hammel-Dahl and Foster lines of electro-hydraulic, pneumatic and steam specialty valves. Anyway at all, you're

automatically thinking General Controls. Check the information request card for your copy of the new Industrial Controls Catalog — or call your local General Controls factory branch office for more information. Your move.

GENERAL CONTROLS

Automatic Controls for Product or Process

Glendale, Calif. · Skokie, Ill. · Guelph, Ontario, Canada

Nine Plants — 44 factory branch offices serving the United States, Canada and Western Europe

For more facts circle 273 on Reader Service card, p 103

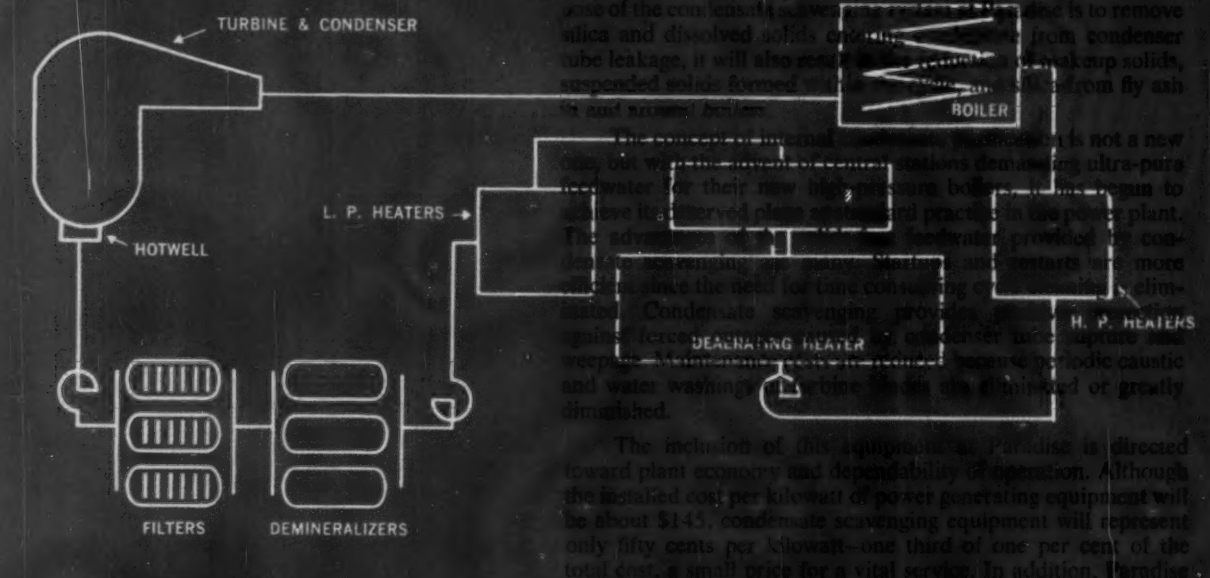
ULTRA-* PURE WATER *for the World's*

MOST POWERFUL TWINS

For the next few years, the Green River near Drakesboro, Kentucky, will be the scene of feverish yet painstaking activity—the construction of the twin units of TVA's Paradise Steam Plant. What will distinguish this station from others in the area, and indeed in the nation, is its size, for each new turbine will produce 650 megawatts—the greatest output of any single power unit in the world.

The plans call for Paradise Station to be as modern as tomorrow, as efficient as human minds and hands can make it. Since it will employ once-through, universal-pressure type boilers, which do not permit any boiler blowdown, it was necessary to provide some positive means of keeping boiler feedwater free from impurities which might eventually result in damage to tubes and turbines and a decrease in boiler efficiency. This problem was solved by incorporating into the design of each unit a system of internal condensate purification to produce ultra-pure water.

Graver condensate scavenging equipment will act as a "kidney" in Paradise Station's Units 1 and 2, continuously treating and purifying internally all of the condensate of both units. Two complete, separate systems have been planned, each to treat the full flow of one unit—6900 gpm condensate flow at the hotwell—and will include externally regenerated mixed-bed demineralizers, prefilters and postfilters. Water will be supplied to the polishing



write for...

CONDENSATE SCAVENGING BULLETIN WC-128
DEAERATING HEATER BULLETINS WC-101C, WC-110
AUTOMATIC TAPE ANALYZER BULLETIN WC-127
TECHNICAL REPRINTS T-157, T-166, T-172, T-181, T-182

Every piece of equipment used with the largest turbines ever built must maintain the highest standards of design, construction and performance. Graver condensate scavenging systems and deaerating heaters again demonstrate the quality of engineering and years of experience which have made Graver a leader in water treatment for the power industry.

***Ultra-Pure Water—by definition, containing less than 50 ppb total solids.**

Industrial Department I-332

GRAVER WATER CONDITIONING CO.

Division of Union Tank Car Company

216 West 14th Street, New York 11, N.Y.

For more facts circle 259 on Reader Service card, p 103

combine high-tensile strength, abrasion resistance, elasticity and resilience in varying degrees for many applications. Those suggested are chute linings, vibration pads, gaskets, belts.—Armstrong Cork Co, Industrial Div

Manual gun for gas-shielded metal-arc welding

55 • Gun and controls are designed for light or heavy fabrication where numerous short welds, off-the-ground welding or emergency repairs are necessary. Operator can weld as far as 50 ft away from the control panel and control panel can be placed 150 ft away from the power source.

Gun carries its own compact reel of wire, weighs 2½ lb. Feeding drive rolls and complete-range wire-speed control are also carried by gun. Control coordinates the wire feed and welding current. — Air Reduction Sales Company

Just circle key numbers on the Reader Service card, page 103, to get complete product story

Centrifugal-pump speed system

56 • Controlled speed system for centrifugal pump and fan drives provides variable speeds from induction motors. Signal from small potentio-

Quiet, Efficient, Convenient

New ROTOJET Electric TUBE CLEANERS ®

Ideal for Hospitals, Hotels, Apartments, and Industries where noise is objectionable.

Rotojet Electric Tube Cleaner thoroughly cleans straight tubes from 25/32" to 4" I.D. in boilers, condensers, evaporators, and heat exchangers so quietly that it can be operated without disturbing anyone.

This self-contained unit comprises a powerful motor, rotatably mounted on a stand, a required length of heavy duty flexible shaft, a 20 ft. cable, and a selection of heads, brushes, drills, and scrapers to meet any cleaning need. The motor swivels and rotates so that tubes on top, bottom, and sides can be cleaned without moving the unit. A few of the many types of heads available are shown below.

Bulletin 107 gives full details of this quiet, efficient, convenient tube cleaner. Send for it now.

Rotojet Electric Tube Cleaner with swing-frame head.

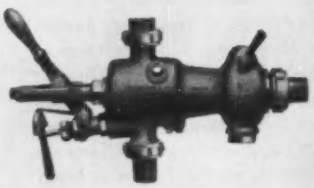
4-way drill and universal coupling.

Expanding wire brush.

ELLIOTT COMPANY – ROTO PLANT
Tube Cleaner Specialists Since 1910
153 Sussex Avenue, Newark, N. J.

For more facts circle 260 on Reader Service card, p 103

have steam injector replacement problems?



If you've tried to replace a steam injector lately, or searched for replacement parts, you've probably had your troubles. Many injector companies have gone out of the business . . . not Sellers—because of other related Sellers' products! We still produce injectors today, to Sellers' continued highest standards. Sellers Injectors are completely interchangeable with other injectors at the connections, with similar capacities.

See us at the Power & Mechanical Engineering—24th Exposition, Booth No. 639, or write us for full information

SELLERS *Injector* CORPORATION

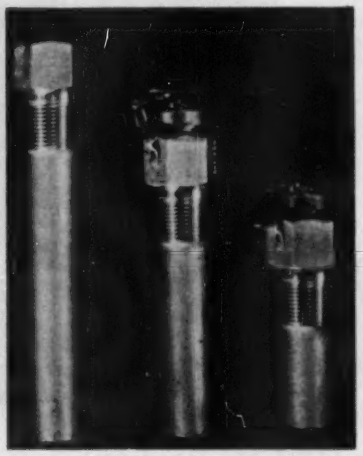
1607-J Hamilton St., Phila. 30, Pa. Since 1848

circle 276 on Reader Service card, p 103

Equipment news

Begins on page 120

meter controls speeds. Potentiometer can be actuated by liquid level, temperatures, pressure. Ratings are from 1 to 30 hp with a 2:1 speed variation. —U.S. Electrical Motors, Inc



Wells have 12-in. immersion length

54 • You can have these wells in any immersion length up to 12 in. on special order. Wells are available for use with thermocouples, bimetallic thermometers and test instruments. —Trinity Equipment Corp

Just circle key numbers on the Reader Service card, page 103, to get complete product story

Photometric absorption analyzers

60 • Analyzers give simple reliable absorption analysis in the 2100 A-ultra-violet- to 3-microns-infrared region, says maker. You can use this unit to monitor or control absorbing components in gas or liquid process streams. Applications are numerous because of a variety of light sources which you can use.—Analytic Systems Company

Compound keeps coal from freezing, corroding

57 • Compound keeps coal from freezing while in transit or storage. Phosphate additive adheres to metal

Checklist of McGraw-Hill HANDBOOKS

☐ **1— NATIONAL ELECTRICAL CODE HANDBOOK**
Just Out. Clearly explains rulings of 1959 electrical code. By A. Abbott. Rev. by F. Stetka. 10th Ed. 779 pp., 387 illus., $10.00

☐ **2— MECHANICAL ENGINEERS' HANDBOOK**
Data on all branches of mechanical engineering. By L. Marks. Rev. by T. Baumeister. 6th Ed. 2270 pp., 2000 illus., $23.50

☐ **3— INDUSTRIAL POWER SYSTEMS HANDBOOK**
Explains modern industrial power system engineering practices. By D. Beeman. 830 pp., 516 illus., $15.00

☐ **4— INDUSTRIAL INSTRUMENT SERVICING HANDBOOK**
How to service, maintain, and calibrate industrial process instruments and controls. By G. Carroll. 848 pp., 375 illus., $16.00

☐ **5— PROCESS INSTRUMENTS AND CONTROLS HANDBOOK**
Explains modern instrumentation for measuring and controlling industrial processes. By D. Considine. 1408 pp., 969 illus., $19.50

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Proved methods and data for the most effective use of piping. By S. Crocker. 4th Ed. 1376 pp., 763 illus., $15.50

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Comprehensive information on materials needed for design, structure, and serviceability. Edited by C. Mantell, 1906 pp., 648 illus., $21.50

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circle 277 on Reader Service card, p 103

How Much Steam Should a Steam Trap Trap?

. . . some answers to commonly asked questions about the primary job of a steam trap

You don't need a doctor's degree in thermodynamics to answer the question at the top of this page. Naturally, a steam trap should trap *all* the steam.

Unfortunately for you, the problem isn't quite that simple. After all, a shut off valve would trap all the steam . . . and condensate, and air, and carbon dioxide as well.

So we'd better amend the answer to the question this way: A steam trap should trap *all* the steam but *must* remove condensate, air and carbon dioxide as rapidly as they accumulate.

With this established, let's take a closer look at what's involved:

A Steam Trap Should Trap All The Steam

If you've had experience with several different makes of traps, you already know that some trap steam better than others. The operating principle of the trap is what makes the difference. We like to talk about it because Armstrong traps are designed so that no steam can get to the orifice. The valve is always water sealed. Result: *More efficient steam utilization, lower fuel costs.*

A Steam Trap Should Remove Condensate

All traps remove condensate—after a fashion. For maximum efficiency in the unit being drained, though, the trick is to get it out without waiting for it to cool and without leaking steam.

Armstrong's water sealed valve takes care of steam leakage. The inverted bucket operating principle opens the trap for water regardless of its temperature. This means you get the condensate out as quickly as it accumulates. Result: *Higher temperatures and better heat transfer in steam heated units.*

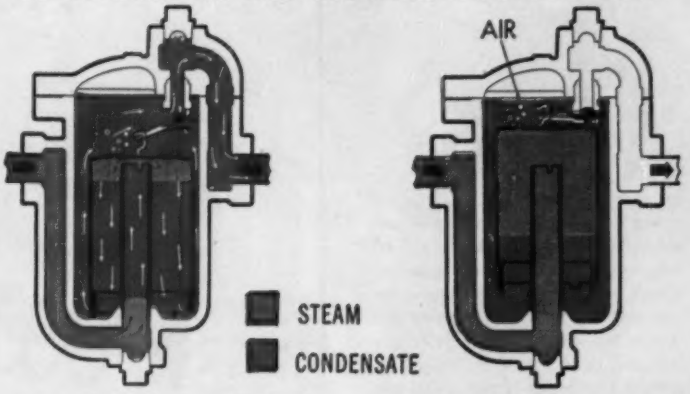
A Steam Trap Should Remove Air and CO_2

Part and parcel of the condensate removal problem is removal of air as well as oxygen and carbon dioxide—two real troublemakers. Air tends to reduce operating temperatures and interfere with heat transfer. CO_2 goes into solution to form corrosive carbonic acid which, for example, can eat unit heater tubes. O_2 aggravates the situation. Believe it or not, but all traps don't properly remove air and CO_2.

By now, you've probably guessed that Armstrong traps *do* remove air and CO_2. Armstrong design (see illustration) provides continuous venting of air and CO_2. By opening suddenly, the Armstrong trap creates a momentary pressure drop to "pump" the air down to be vented. Result: *Higher temperatures, faster heat-up, better heat transfer and reduced corrosion.*

Note: When required, specially sized air vents are furnished. For fast heat-up of low pressure on-and-off units, Armstrong provides open float and thermostatic air vent traps.

HERE'S THE STEAM TRAP DESIGN THAT GETS RID OF CONDENSATE AND AIR WITHOUT STEAM LOSS



Trap open. Condensate entering trap has caused bucket to lose buoyancy. Weight of bucket times leverage pulls valve open. Air is discharged along with condensate.

Trap closed. Steam has floated inverted bucket; valve is held tightly closed by system pressure. Air entering trap passes through bucket vent and accumulates at top of trap.

What's the Final Answer?

Summing it all up, you'll get the best service from steam heated units that are equipped with traps designed to trap *all* the steam and remove air and condensate as quickly as it accumulates. In our prejudiced viewpoint, this means Armstrong traps. More important are the several thousand users of Armstrong traps who have proved the point.

See our Catalog in Sweet's Plant Engineering File

Before you make up your mind, though, consider the minimum maintenance requirements of Armstrong traps . . . and the convenient assistance your local Armstrong Representative provides. These are important plus values.

Put Up or Shut Up

We're so confident that we "put up". Armstrong traps are unconditionally guaranteed to satisfy. So you can find out for yourself with practically no risk. If you're not completely satisfied with the way they do their job, you can get your money back.

• • •

The 44-page Armstrong Steam Trap book goes into greater detail on these and other Armstrong features. It also discusses trap selection, installation and maintenance. Ask your Armstrong Representative for a copy or write

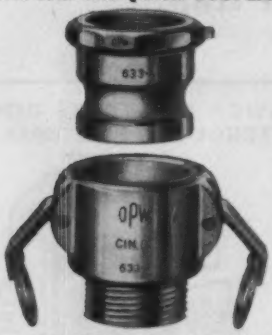
Armstrong Machine Works
8122 Maple Street
Three Rivers, Michigan

ARMSTRONG STEAM TRAPS

For more facts circle 278 on Reader Service card, p 103

IT'S EASY

WITH KAMLOK QUICK COUPLERS



You save production time . . . when you replace time-wasting hose and pipe connections with Kamlok Quick Couplers. No tools needed. Your operator can do the job himself. Just fit together and pull the two cam arms down. Use them wherever your hose or pipe connections are periodically uncoupled (once a week or oftener). We probably have one to fit your needs. Why not send for more information? Inquiries are invited.

Fastest—safest—surest couplings known.

4

OPW-JORDAN | 6013 Wiehe Road Cincinnati 13, Ohio

circle 279 on Reader Service card, p 103

3 Distinct Design Advantages Eliminate

Costly Flow Failures with

Quick Operating
Non Sticking
Tight Seating

Magnatrol SOLENOID VALVES

Attain dependable, accurate, automatic or remote control of liquids or gases with MAGNATROL VALVES.
Every MAGNATROL VALVE is factory tested — guaranteed free from defects in material and workmanship.

Catalog mailed upon request

Magnatrol Valve Corp. Hawthorne 10 New Jersey

circle 280 on Reader Service card, p 103

Equipment news

Begins on page 120

surfaces to provide protection against oxidation and electro-chemical corrosion. Formulations for either dry or liquid applications are available. —Hardy Salt Company

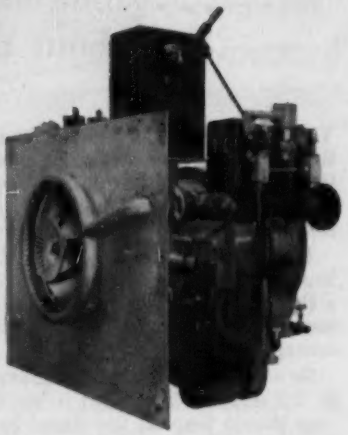
Phase sequence indicator features 2-color panel

66 • Indicator's panel markings are protected by a new laminating process—they're beneath the surface to resist heat, oil, scratching and marring. Instrument is designed for direct connection, without switching, to polyphase circuits with voltages between 104 and 480 v. Instrument's frequency range is 30 to 1000 cycles. —Opad Electric Company

Just circle key numbers on the Reader Service card, page 103, to get complete product story

V-type gas-engine compressor rated 5500 bhp

59 • Turbocharged, 2-cycle machine for pipeline gas transmission combines high hp, low fuel consumption, simplicity and dependability, says maker. Compressor cylinders located on one or both sides of crankcase make maximum use of space and give cylinder flexibility for wide range of applications. Unit can be fitted with as many as eight large cylinders to handle all types of pipeline and process requirements including multiservice applications where several gas streams are compressed by one machine.—Clark Bros Co



NEW . . . FABER'S COMPACT PACKAGE OIL-GAS-OR COMBINATION BURNER

Faber's rugged new "AF" Packaged Burner—field tested over 5 years' continuous duty—offers these advantages:

COMPACT • Unique space-saving design integrates burner, blower and controls. All components accessible for inspection or maintenance.

EFFICIENT • Unique axial flow, hollow shaft forced draft fan, adjustable curved vane air register and Voltrol fan inlet vanes for efficient turbulent fuel-air mix over wide range.

ADAPTABLE • Fan unit and "V" belt drive adjustable to heavier load for modest plant expansion. Motor, turbine or combination drive. Fully automatic, semi-automatic or manual controls. Standard electric drive with oil immersed gears and heavy duty motor develops 100 ft pounds of torque. Hydraulic or pneumatic controls available.

SAFE • Complete programming unit for flame safeguard, interlocked with safety circuit.

Write for Faber Catalog 59-1:
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240 West Washington Street,
Norristown, Penna.
or any handy Faber dealership

FABER
ENGINEERING COMPANY, INC.

Manufacturers of Industrial Oil and Gas Burners, Fuel Oil Pump and Heater Units, Special Pumping Units, Since 1927 F-197

circle 281 on Reader Service card, p 103

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11,078,750 KW

IN CENTRAL STATION CAPACITY

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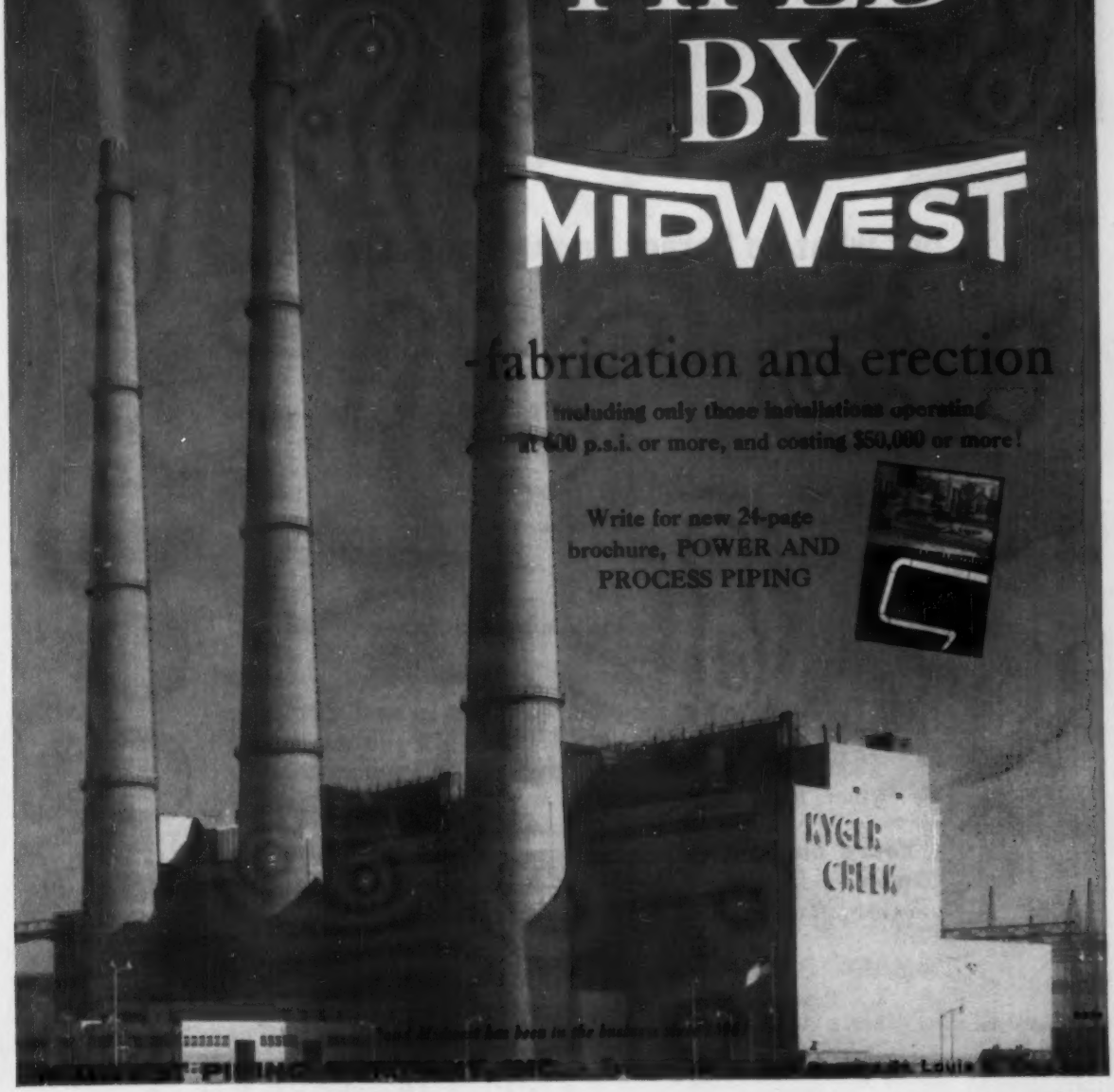
-fabrication and erection

including only those installations operating at 600 p.s.i. or more, and costing $50,000 or more!

Write for new 24-page brochure, POWER AND PROCESS PIPING



For more facts circle 282 on Reader Service card, p 103

MAYBE HORSES THINK SEAT RINGS NEVER NEED REPLACING...

but what do horses know about valves?

You know from bitter experience that when pipe chips, boiler scale or other hard particles catch between wedge and seat, the wedge will be damaged and the seat will be scored. You have to replace both wedge and seat or dump the valve. And no horse can tell you different!

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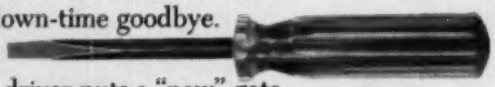

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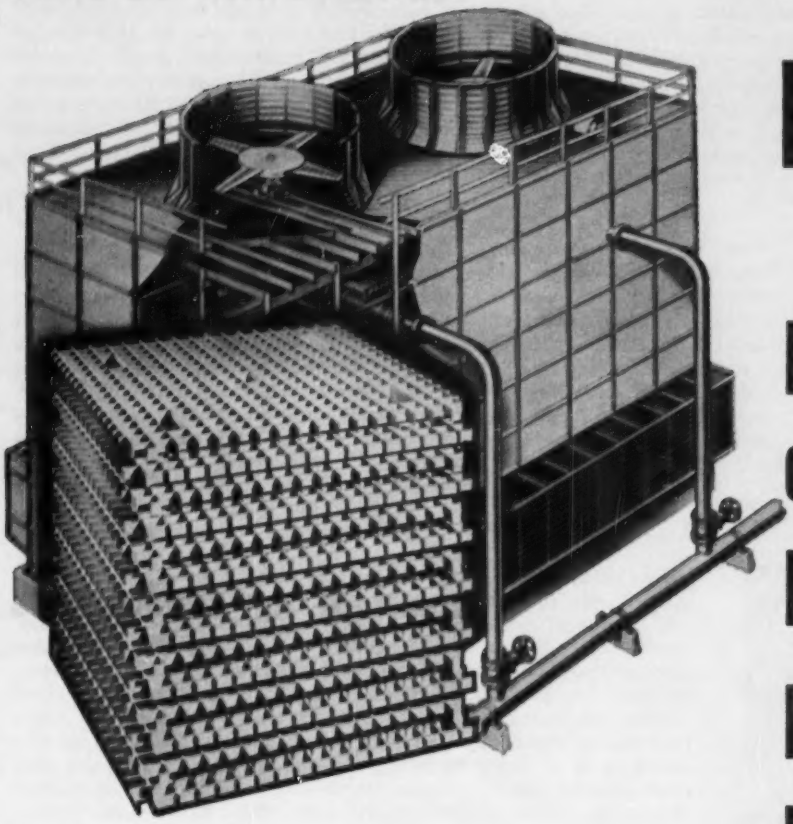

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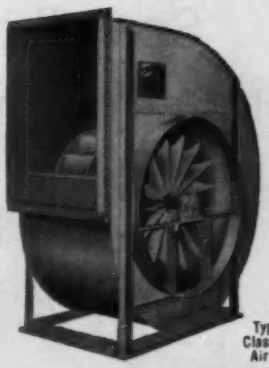

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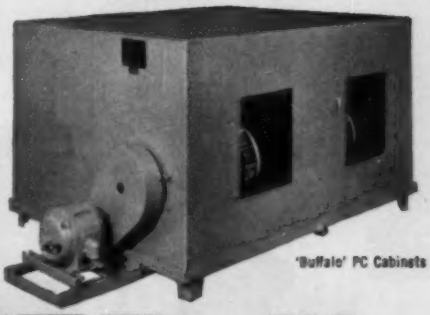

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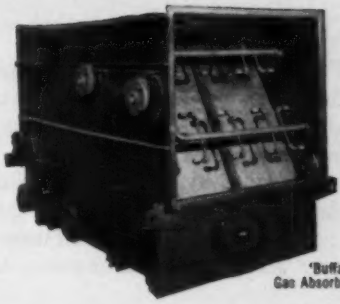

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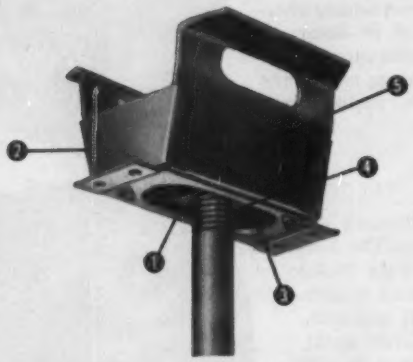
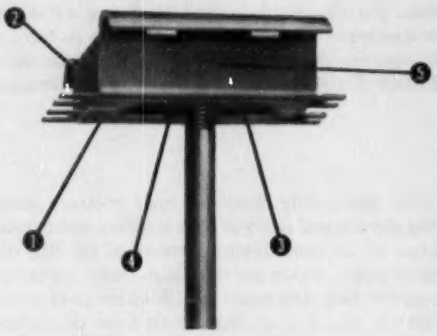


GRINNELL WEDGE TYPE CONCRETE INSERT (Steel), FIG. 281 — 1. Nut and rod may be preassembled for fast installation 2. Wedge-shaped body compresses in concrete for extra strength 3. Knockout (already removed) seals out concrete 4. Full 1¾ inch lateral adjustment 5. Supports up to 1200 lbs.



GRINNELL LIGHT WEIGHT CONCRETE INSERT (Steel), FIG. 285 — 1. Designed for light-duty use in concrete 2 inches and thicker 2. Arched flanges take reinforcing rods 3. Knockout seals out concrete 4. Full 2 inch lateral adjustment 5. Supports up to 400 lbs.

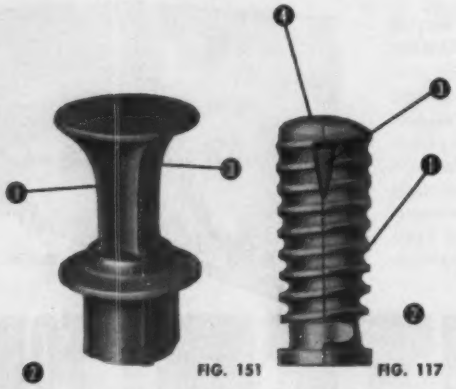


FIG. 151 FIG. 117

GRINNELL SCREW CONCRETE INSERT (Malleable Iron), FIG. 151 — 1. Malleable iron for extra strength 2. Pipe sizes through 12 inches. 3. Supports up to 2,120 lbs. **GRINNELL EXPANSION CASE (Malleable Iron), FIG. 117** — 1. Malleable iron, cadmium plated, assures high resistance to impact, corrosion 2. Pipe sizes through 16 inches 3. Rod moving upward forces wedge-shaped nut downward, expanding and locking case in concrete 4. Supports up to 1300 lbs.

GRINNELL CB "Closed Back" CONCRETE INSERT (Malleable Iron), FIG. 282 — 1. One body size accommodates 5 sizes of rods 2. Slot takes reinforcing rods to assure maximum load rating. 3. One-piece body prevents concrete seepage 4. Teeth on insert and nut hold rod firmly in place 5. Homogeneous composition of malleable iron throughout 6. Supports up to 1430 lbs. (Also available in smaller "CB-JUNIOR" size that supports up to 770 lbs.)

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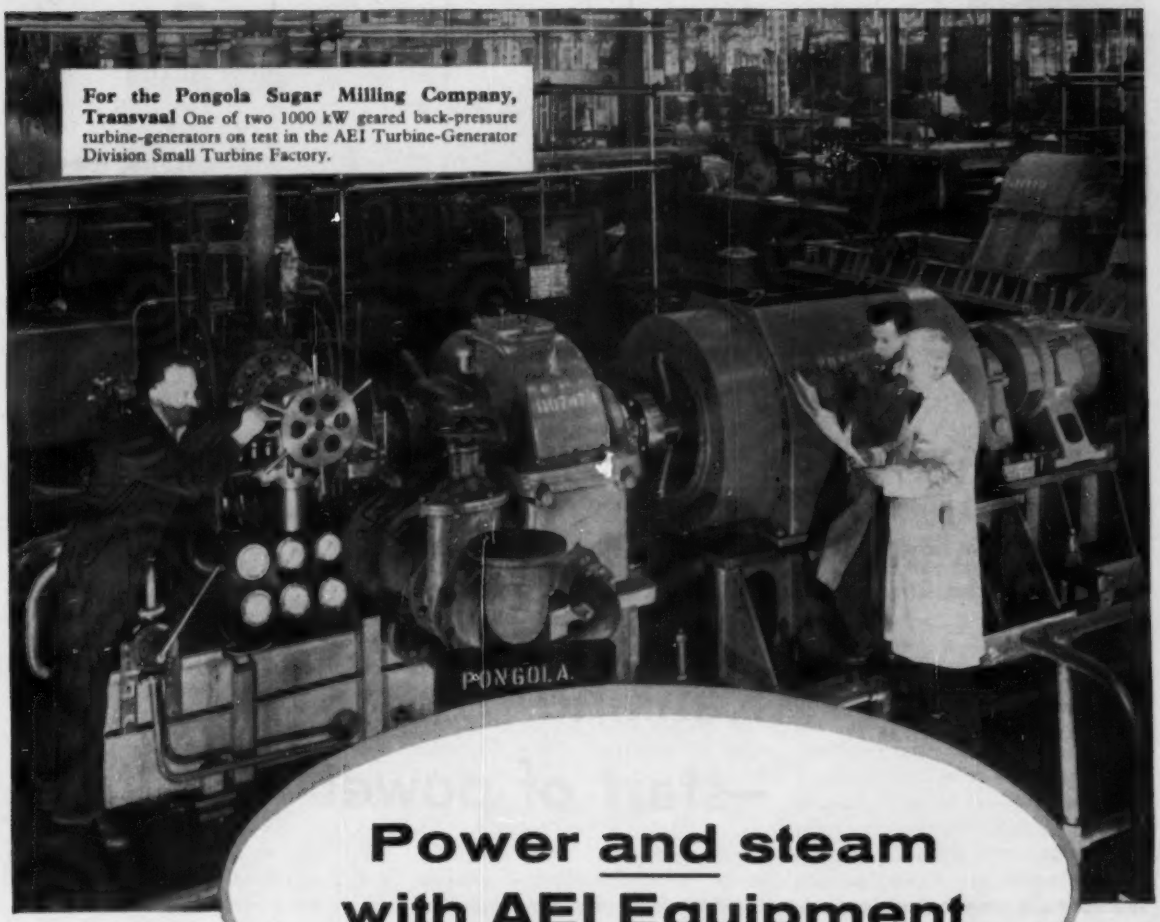

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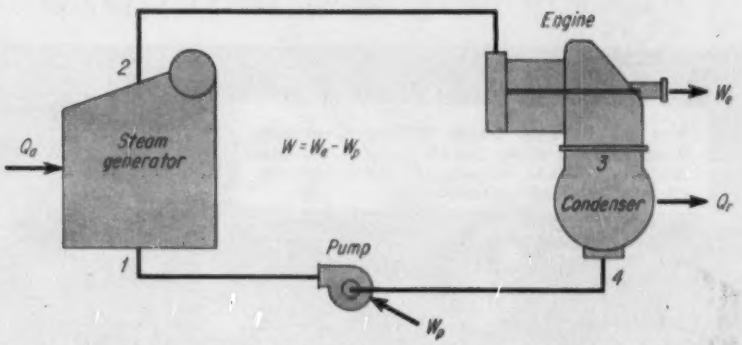


1 Rankine cycle assumes the simplest type of power plant with steam generator, engine or turbine, condenser and feedwater pump. Ideal cycle assumes no other auxiliaries

By B G A SKROTZKI, Associate Editor

The oldest cycle of boiler, engine, condenser and feedwater pump laid the basis for today's giant power generating stations. To know how well these old plants ran, the Rankine cycle was used as an ideal standard for comparison

Rankine cycle: —start of power industry

We have sharpened our understanding of steam processes in the last several parts; now let's see how steam processes can be applied in power-production cycles. The simplest one and oldest is the Rankine cycle, Fig. 1. Here we have a simple boiler supplying steam to an engine (a turbine in this case); the turbine exhausts its steam to a condenser. Condensed steam, condensate, is then pumped back to the boiler as feedwater.

We must have many more auxiliaries to run an actual plant of this type, but as an ideal standard we only consider what happens to the water and steam acting as the working fluid in this steady-flow closed cycle. Reduced to this simple idea we find that energy enters and leaves the cycle at only four points.

To heat the water and vaporize it to steam at constant pressure we have an energy input Q_a to the boiler. This successively changes the phase of the working fluid at state *1* from a subcooled liquid to a saturated liquid, to a mixture of saturated liquid and vapor, to a dry saturated vapor and perhaps to a superheated vapor at state *2*. Then $Q_a = H_2 - H_1$ for this steady-flow constant-pressure process.

The steam with H_2 then flows as a wet or dry saturated steam or as superheated steam to the turbine. In the turbine the steam expands adiabatically at constant entropy to a lower pressure at state *3*. During the expansion it produces mechanical work W_e, the useful output of the cycle. Then $W_e = H_2 - H_3$ for this steady-flow process.

At state *3* the steam as a wet saturated vapor enters the condenser to transfer its unavailable energy Q_r to the cooling water. In this way the energy leaves the closed cycle. The condensed vapor falls as a saturated liquid to state *4* in the bottom of the condenser, the condenser hotwell. For this constant-pressure steady-flow cooling process $Q_r = H_3 - H_4$.

The pump draws the condensate from the hotwell at state *4* to pressurize it to state *1* for reinjection into the boiler as a subcooled liquid. The pump needs a mechanical energy input W_p to work on the water. This input to the cycle as a constant-entropy adiabatic compression is then $W_p = H_1 - H_4$

Thermal efficiency. Since this is a closed cycle, all energy entering must equal all energy leaving:

$$Q_a + W_p = W_e + Q_r \qquad (1)$$

Rearranging we get:

$$W_e - W_p = Q_a - Q_r \qquad (2)$$

The net work output of the cycle can then be written as:

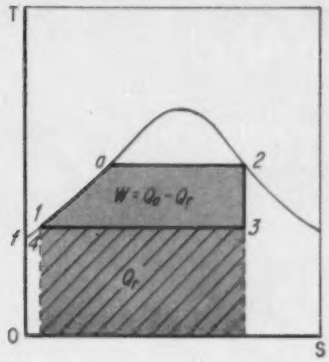
$$W = W_e - W_p = Q_a - Q_r \qquad (3)$$

The efficiency of the Rankine cycle will then be:

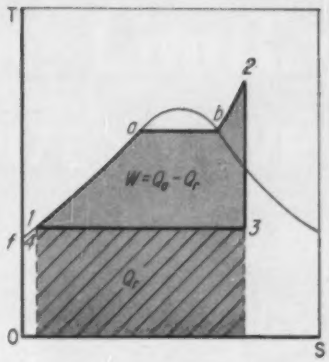
$$e = \frac{W}{Q_a} = \frac{Q_a - Q_r}{Q_a} = 1 - \frac{Q_r}{Q_a}$$

$$= 1 - \frac{H_3 - H_4}{H_2 - H_1} \qquad (4)$$

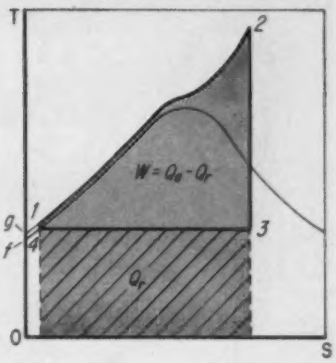
Thermal efficiency of the cycle depends on the enthalpy of water and



2 Rankine cycle using dry saturated steam from boiler now seldom used



3 Rankine cycle using superheated steam has drier exhaust leaving the engine



4 Supercritical-pressure Rankine cycle has triangular-shaped net work area

steam at the four states between the components of the plant. These can be chosen as needed for a particular situation of the power plant.

T-S graphs, Fig. 2 to 4, are standard tools for describing steam plant cycles. In Fig. 2 we have a simple Rankine cycle where the boiler produces dry saturated steam for the turbine. At state *1* the boiler receives the subcooled water and heats it to saturated water at state *a*. For low pressures, under about 400 psia, the constant-pressure line is practically coincident with the saturated vapor locus. From *a* to state *2* the boiler vaporizes the saturated water to dry saturated steam. Area under *1-a* is the heat added to bring the water to the saturated-liquid phase; area under *a-2* is the heat added to vaporize the saturated water to steam. The total gray area under *1-a-2* is Q_a, the heat added to the cycle.

The constant-entropy process *2-3* is the steam expansion in the turbine to produce mechanical work W_e. Since it's adiabatic, no heat transfer is involved.

The constant-pressure cooling process *3-4* is the condensing of the steam in the condenser. Area under *3-4* measures heat rejected by the working fluid Q_r. This is the unavailable energy and is marked by the hatched area. The toe of the diagram marked *4-1* is the constant-entropy compression of the water by the pump input W_p. For low pressures this appears as a common point and W_p is almost zero.

The areas Q_a and Q_r have three common boundaries and since this is an ideal cycle the net remaining area is $Q_a - Q_r$. In equation (3) we have shown that this equals the net work output of the cycle for heat input Q_a.

Another way to interpret these charts is to remember that the total area under *f-1-a-2* is H_2 and the area under *f-1* is H_1. Similarly the total area under *f-4-3* is H_3 and under *f-4* is H_4. We showed before that $H_2 - H_1 = W_e$ and $H_3 - H_4 = Q_r$.

In Fig. 4 the cycle uses a high-pressure boiler; here *g-1-2* is the boiler-pressure locus and the area underneath *g-1* is H_1, the enthalpy of the subcooled water discharged by the pump, entering the boiler. The area under *f-4* is H_4, the enthalpy of saturated water entering the pump from the condenser hotwell. Since $W_p = H_1 - H_4$ the net area *f-g-1-4* measures W_p. Note particularly that in Fig. 2 to 4 all the net areas enclosed in the cycle processes represent net work of the W of the cycle and not the gross work of the engine W_e. The latter equals the area of W plus the net pump work area *f-g-1-4*.

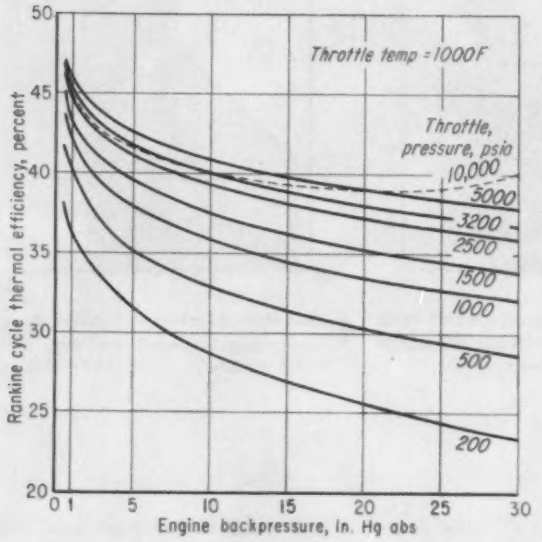
Superheating, Fig. 3, of the steam in the boiler or steam generator brings the cycle processes out of the "steam dome" on the chart. The area under *1-a* again measures the heat to raise the subcooled liquid to the saturated state; area under *a-b* measures the heat to vaporize the saturated liquid; area under *b-2* measures the heat to superheat the saturated steam; total gray area, of course, measures heat input Q_a to the boiler, and therefore the cycle.

Superpressure, Fig. 4, means that the boiler pressure or engine-inlet pressure is above the critical 3206.2 psia. The constant-pressure heating process *1-2* lies entirely above the saturation "steam dome." To be strictly consistent the steam at state *2* should not be called superheated because there is no saturation temperature corresponding to a superpressure. But it is becoming common practice to call any steam temperature superheated when it's above the critical 705.4 F.

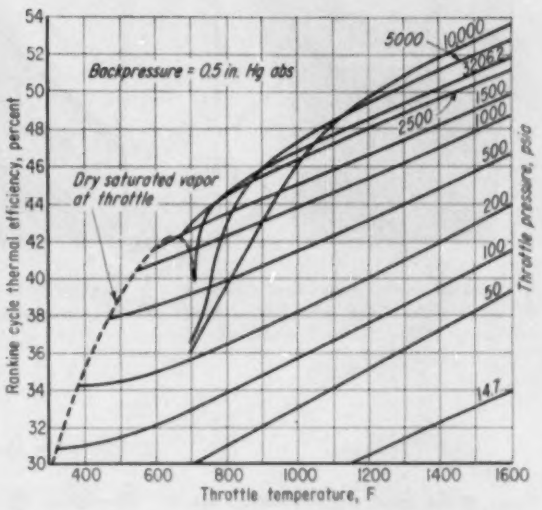
The net work area begins to assume the shape of a triangle for this pressure level. The pump work area as we discussed before is outside the net work area.

Thermal efficiency of the Rankine cycle as in all thermodynamic cycles depends on the temperatures of heat addition and heat rejection. High-temperature addition and low-temperature rejection aid in increasing efficiency. The heat rejection is usually at constant pressure and temperature, the temperature primarily depending on the pressure that can be maintained at exhaust by the condenser.

The heat addition, however, is usually at variable temperature so it's the *average* temperature that determines the efficiency. For instance, in Fig. 2 to 4 all of the Q_a's start at about the same low temperature T_1, but they progressively have higher end temperatures T_2. Too, all three



5 Thermal efficiency of Rankine cycle with constant throttle temperature drops with increasing backpressure on engine



6 Rankine-cycle thermal efficiency varies with throttle pressure and temperature, generally rises with increasing temperature

have the same Q_r and $T_3 = T_4$. So the thermal efficiencies of the three cycles increase from Fig. 2 to 4. The increasing areas of the W's show this for these ideal cycles.

Backpressure, Fig. 5, has a marked effect on Rankine-cycle thermal efficiency. The severity, though, varies with the throttle pressure—that is, inlet pressure to the turbine or engine. With constant throttle temperature of 1000 F and 200-psia, throttle pressure thermal efficiency drops from 36.3% to 23.3% as backpressure rises from 1-in.- to 30-in.-Hg abs. But at 5000 psia the thermal efficiency drops from 46% to 37.7%. The drops are 13.0% against 8.3%. Backpressure change has less effect with higher throttle pressures.

Increasing slopes of the constant-pressure curves with lowering backpressure show the high advantage of maintaining low backpressures on steam engines and turbines. This can be achieved by minimizing the temperature differential between cooling water and exhaust steam.

Throttle P-T, Fig. 6, has a controlling effect on Rankine-cycle efficiency. Low backpressures were achieved early in modern powerplant development, minute gains being made in the last decade. But continuing efforts are being made to harness higher and higher throttle pressures and temperatures. Fig. 6 shows why.

The dashed line shows how efficiency varies for cycles using dry saturated steam as the throttle temperature increases. The efficiency reaches a maximum at around 660 F and then drops sharply as it approaches the critical of 705.4 F.

All the constant-pressure lines show that increasing temperatures raise the thermal efficiency. However, we can't say that increasing pressures also consistently raise efficiency unless we specify throttle temperatures above 1130 F. In the higher temperatures, note the decreasing incremental return in efficiency with rising pressure.

Steam rate. An operating convenience giving a quick performance index of a steam engine is the steam rate SR. Knowing the total lb of steam that passed through an engine to produce a given kwhr output we get:

$$SR = \frac{\text{Total steam flow, lb}}{\text{Total shaft output, kwhr}} \quad (5)$$

Since there are 3412 Btu in each kwhr the steam rate is related to the work done per lb W as:

$$SR = 3412/W$$

Heat rate. Another way of measuring cycle performance is the heat rate which states the Btu input for each unit of output. This is:

$$HR = SR(H_2 - H_1) \quad (7)$$

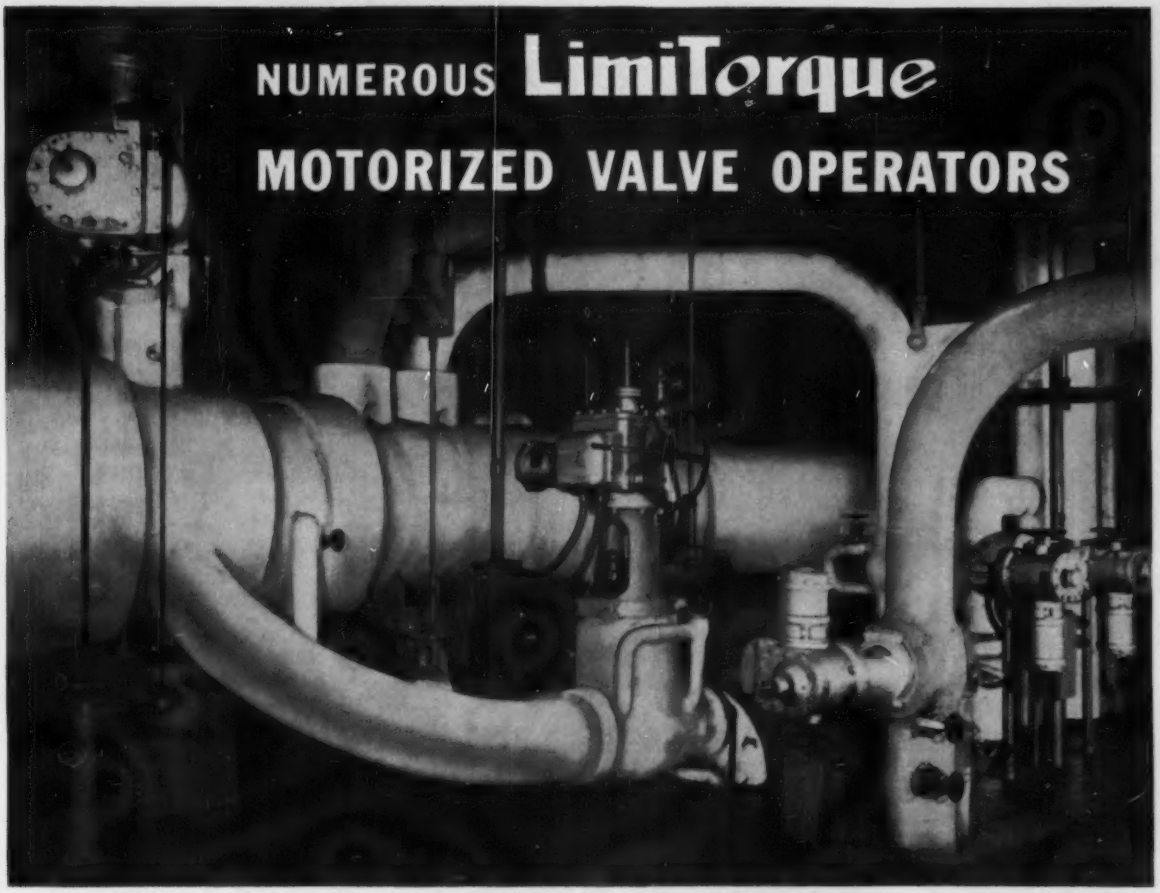
The heat rate and thermal efficiency are related by:

$$e = \frac{3412}{SR(H_2 - H_1)} = \frac{3412}{HR} \quad (8)$$

For practice, get out your steam tables and slide rule and check some of the figures on the curves of Fig. 5 and 6. Don't forget to account for the compressed liquid correction wherever it amounts to more than one Btu. This you can get from Keenan and Keyes' Table 4. Your Mollier chart can be used to advantage to find H_3—some of them you'll have to figure from the saturated steam tables because the chart is not wide enough to include the lower entropy values.

As you probably recognized, we seldom use the Rankine cycle in our modern plants, except for the tiny ones. The cycle is valuable, though, in giving a fundamental introduction to the factors that control the efficiency of a steam cycle—these must be understood before we study the more advanced forms used today.

Next month we study the effects of irreversibilities on the Rankine cycle.



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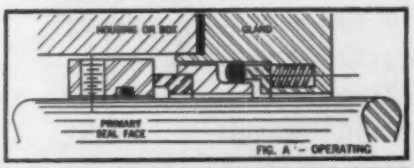

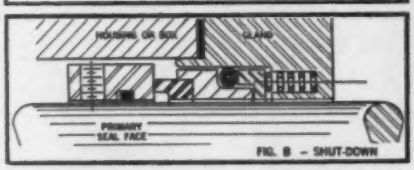

When the COUNTERPOISE SEAL *is in operation (fig. A) springs are disengaged and the sealing faces are held in contact by uniform fluid pressure only! During shut-down (fig. B) springs are in operation, taking over the closing function normally maintained by fluid pressure when the pump is in operation.*

Both new seals operate on the sound principal that sealing faces should *not* be mated by the unreliable and uneven pressures of springs. Conventional springs become fatigued, clogged by sediment or corroded thus causing uneven face wear. A warped face rapidly loses its sealing action. In the CHESTERTON COUNTERPOISE SEAL the fluid pressure maintains a uniform, balanced face pressure eliminating unevenly worn faces. The springs only operate during shut-down or sudden vacuum conditions. They are isolated from corrosive fluids or abrasives. Become acquainted with the newest and most advanced seals in industry by sending for our brochures and then decide which of these two ingenious seals will solve your problem.

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Bookshelf

Electrochemical Engineering, Fourth Edition, *by C L Mantell, PhD. 680 pp, illust, cloth, $16.50. McGraw-Hill Book Company, Inc, 330 W 42nd St, New York 36, N. Y.*
This book is the fourth edition of Dr Mantell's *Industrial Electrochemistry*, retitled and largely rewritten. Industrial processes get a hard look, with some fundamental theory for background. New products and processes, new sources of raw materials, rising sizes of cell and furnace units are covered.

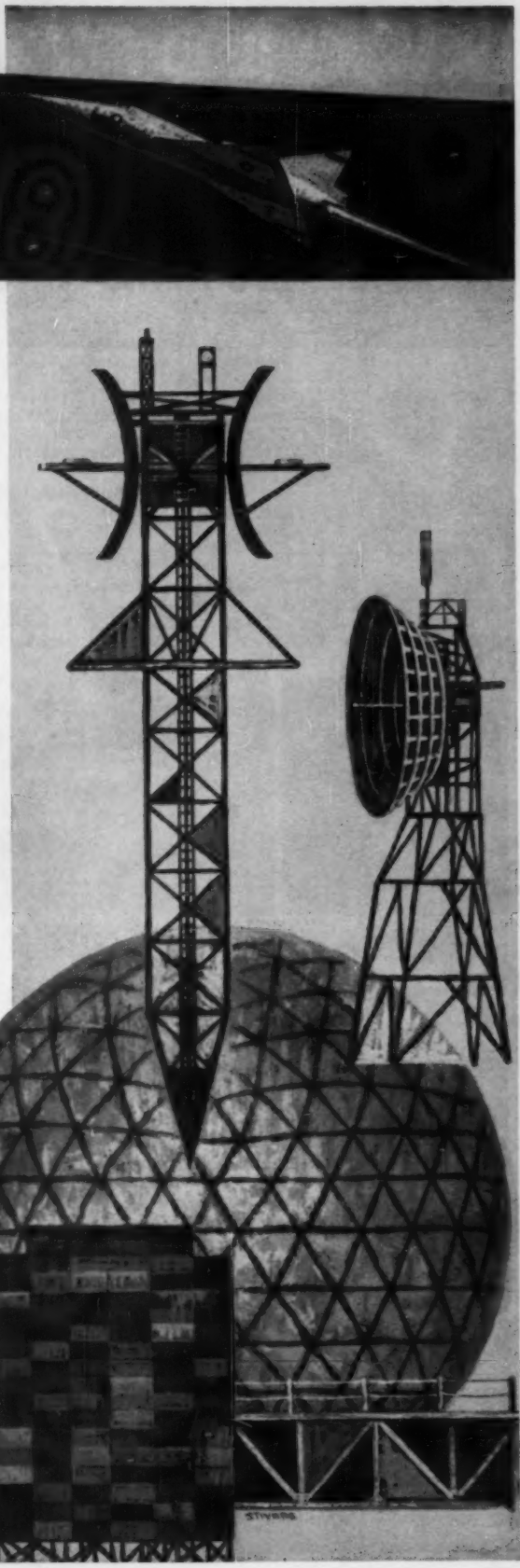
A new chapter, "Electrothermics in general," discusses furnace design and construction. Part 7, "Engineering," treats production of dc energy for electrolysis, describes construction materials, rounds up cost factors. The volume is designed to guide practicing engineers as well as students in commercial and engineering phases of the electro-process industries.

Techniques of Plant Maintenance and Engineering 1960, Volume 11. *341 pp, 66 illust, $10.00. Clapp & Poliak, Inc, 341 Madison Ave, New York 17, N. Y.*
A major resource and reference volume in its field, this book of the proceedings of 1960 technical sessions of the National Plant Maintenance and Engineering Show reflects the growing importance of maintenance and engineering functions in industry. It reveals industry's approach to key production problems in keeping plants and machinery running at optimum efficiency. It reports on the advance of automation from research and experiment to reality, significance of automation in maintenance operation.

Book presents 34 papers, texts of all the discussions, comments, questions and answers of speakers and panel members. Nearly 2000 practical, everyday problems are discussed.

Electromagnetic Fields, Energy, and Forces. *By R M Fano, L J Chu and R B Adler, Dept of Electrical Engineering, Massachusetts Institute of Technology. 520 pp, cloth, $12.00. John Wiley & Sons, Inc, 440 Fourth Ave, New York 16, N. Y.*
A consistent microscopic theory of electromagnetism is developed, and the relation between circuit theory

READY ON THE DIESEL LINE?



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It's all in a day's work.

Jet speed, solid service and competitive price — that's the good word around our plant.

And it's been the word since 1898.

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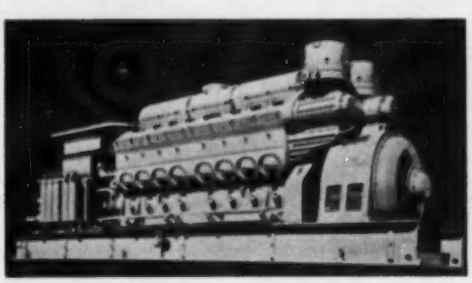
Go Schoonmaker!



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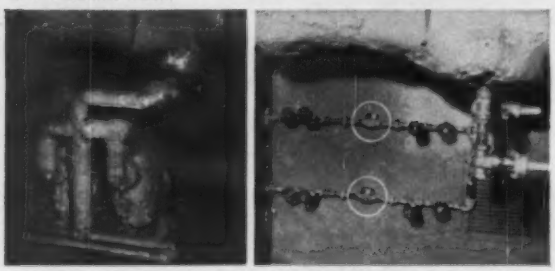
SARCO TOPICS

How major New York office building solved steam trapping problems through trap standardization

Recently, the Office Building at 625 Madison Avenue, New York, — erected in 1931 and comprising 420,000 square feet on 17 floors — discontinued its own steam generation and switched to district steam. The changeover made the inadequacies of old bucket and float traps more apparent than ever, and afforded an occasion to modernize trapping. Here's how major improvements were made.

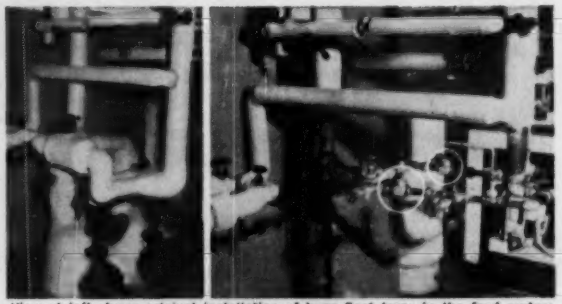
The first problem was maintenance. All maintenance had to be done at night or on weekends, at overtime rates, because the system could not be shut down during business hours. Frequent breakdowns added to maintenance costs. After the installation of Sarco Thermo-Dynamic Steam Traps, Type TD-50, trap maintenance — and therefore maintenance costs — have been reduced almost to zero. The engine room crew are now free for other jobs, and savings in both regular and overtime manhours are considerable.



Left picture shows the steam service main from the street, with massive float trap installation. Picture at the right is view of installation after the changeover to TD-50's (circled).

The second problem was water-hammer, caused by passage of live steam into return lines when traps failed open. (When traps failed closed, water accumulated in steam supply mains and equipment.) Installation of TD-50 steam traps ended waterhammer and consequent damage to equipment, because the TD-50 discharges condensate as rapidly as it is formed and prevents steam from entering the return system.

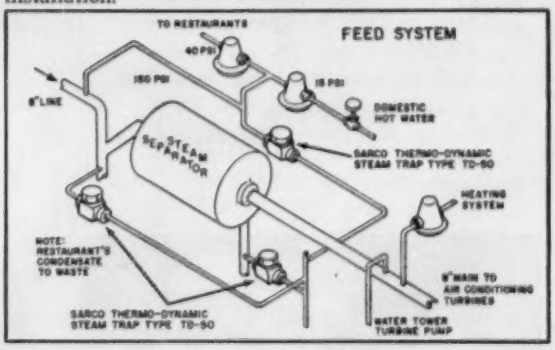
The third problem was live steam loss. Live steam, discharged into the return lines, not only represented a great waste of heat energy, but caused waterhammer in the return, and raised the condensate temperature to an excessive level. (Incidentally, although the building's district steam system is, of course, not faced with this problem, hot condensate passing through condensate pumps can damage pump seals.) These problems are eliminated through the use of TD-50's. No steam can be blown into the return main because the TD-50 shuts off *positively*, blocking any possibility of live steam being discharged into the return. Savings are considerable.



View at left shows original installation of huge float traps in the feed system of the building. View at the right shows compact installation of Sarco TD-50 Steam Traps (circled).

These benefits were achieved by replacing bucket and float traps with Sarco Thermo-Dynamic Steam Traps, Type TD-50, matched and correctly sized to the application. For example, many ½" bucket traps were replaced with ⅜" TD-50's, which have ample capacity for the job.

The TD-50's pressure range of 10-600 psi made it possible to standardize on one steam trap for a variety of applications that formerly required traps of many different types and pressure ratings. Finally, changeover took only 30 minutes per trap for each compact TD-50 installation.



Schematic hook-up of the converted feed system.

The success of this TD-50 installation led Collins, Tuttle Co., Inc., managers of the building, to substitute Sarco Thermo-Dynamic Steam Traps for competitive bucket traps in two other major New York buildings.

For more information on Sarco Thermo-Dynamic Steam Traps, contact your Sarco Sales Representative or district office, or write.

2165

SARCO

SARCO COMPANY, INC.
625 MADISON AVENUE, NEW YORK 22, N. Y.
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STEAM TRAPS • TEMPERATURE CONTROLLERS
STRAINERS • HEATING SPECIALTIES

SARCO

Here are 7 Sound Reasons Why the Thermo-Dynamic® Does a Better Job of Trapping

1. *Simplicity*—has only one moving part. 2. *Maintenance*—practically zero. 3. *Wide pressure range*—one trap for all pressures from 10 to 600 psi. 4. *Uniform performance*—operates equally well on heavy, light, or no condensate load. 5. *Operates against back pressures*—up to 50% of inlet pressure. 6. *Rugged*—unaffected by superheat, water hammer, vibration, or corrosive condensate. 7. *Minimizes inventory* of spare parts.

Maintenance Time: 40 Seconds. If it now takes your maintenance crew more than a couple of minutes to service an ordinary trap, you're throwing away valuable time. This Sarco Thermo-Dynamic can be cleaned, blown out if necessary, and reassembled on the line in as little as 40 seconds.

For Prompt Information on the TD-50 . . . or for fast help on the efficient solution of any steam trapping problems, get in touch with a SARCO District Office, Sales Representative, or Distributor. (There's one near you.)

Only SARCO makes all 5 types:

Thermo-Dynamic* • Thermostatic • Liquid Expansion • Float Thermostatic • Inverted Bucket

*U.S. Pat. No. 2,817,353 TM Reg. U.S. Pat. Off. 1409

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circle 291 on Reader Service card, p 103

Bookshelf

Begins on page 144

and field theory discussed in this new book. The theory is developed in successive steps from the Lorentz force, the integral form of Maxwell's equations in free space.

In general format this is a text, but its sponsors describe it as a "report on a research program"—aimed at evolving an undergraduate core curriculum in electrical engineering. Idea is to begin with a broad foundation for engineering application of the sciences, rather than limit teaching to individual industrial practices. Basic principles get priority over current technology. In its special field, this book tries to provide the basis for a continuing career in an ever-changing technology.

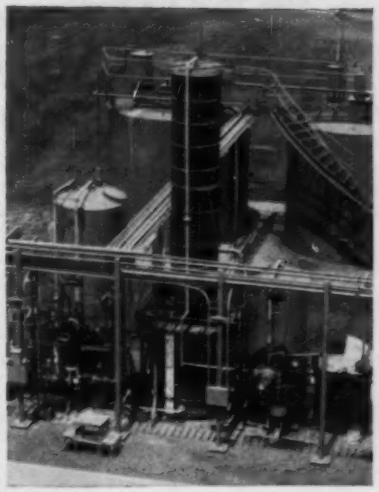
Mechanical Design of Hydro Plants, Volume 3 *(Third volume of Technical Report 24, Design of TVA Projects). Tennessee Valley Authority. 986 pp, 368 illust, 27 tables, 58 design drawings, $3.75. TVA Treasurer's Office, Knoxville, Tenn.*

Engineering work in designing mechanical installations for the primary water-control structures of TVA, related improvements in reservoir areas are covered in this third volume. Volume 1 reported on structural design, Volume 2 handled the electrical side of the projects.

After summarizing TVA's first 25 years' experience, plus location, chronology, cost and arrangement of mechanical installations for 23 dams, book details design, selection and erection of the hydraulic turbines. Turbine governors come next. TVA's experience with auxiliary power generators, elevators, compressed-air systems, raw- and treated-water systems, oil and oil handling, piping design, etc—all the energy systems as applied to major hydro projects are taken up in turn. Final chapter goes into operating requirements of the mechanical-design dept, including coordinating designs, drawing, schedules and procedures. Sample spec bid, test and operating data follow in the appendixes. This report should be useful to many engineers and constructors in hydroelectric work.

ILLCO-WAY

ionXchange



"SILICA: 0.003 PPM, OTHER SOLIDS UNMEASURABLE..."

With some doubt as to the outcome, the de-ionization units pictured above were installed outdoors at a Texas power and light company, to replace evaporation equipment as a means of purifying feed water for a high-pressure boiler. After three years, results far exceeded guarantee and expectations. From raw water containing 27 ppm of silica and dissolved solids totaling 365 ppm, the quality of the effluent is reported as: "Silica, zero to 0.005 ppm, average 0.003 ppm. Other solids are unmeasurable."—This is a good example of what modern ILLCO-WAY ionXchange can accomplish.

BOILER FEED WATER FOR POWER PLANT

The particular plant shown above consists of a cation exchanger, an aerator, and a mixed-bed deionizer. The large tanks in the background hold a supply of regenerants. Operation is manual throughout, a preference of the purchaser. *Results have proved even more economical than expected.*

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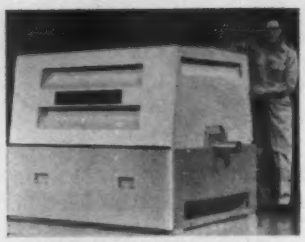
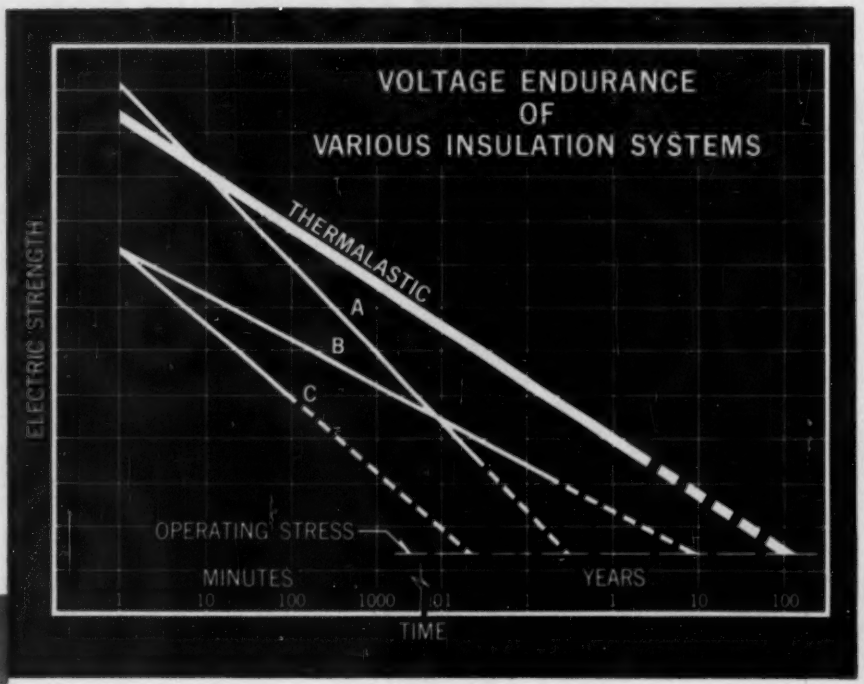


MORE VALUE FOR YOUR LARGE MOTOR INVESTMENT . . .

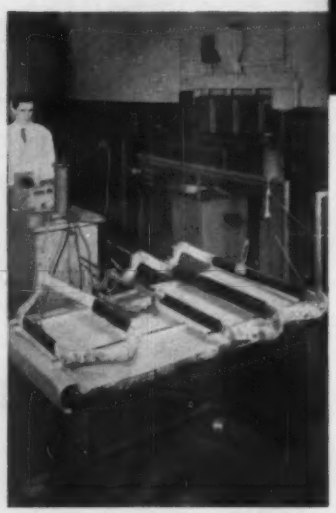
Westinghouse F/A Motor insulation

Thermalastic®, the "insulation with a memory," has been protecting the coils in more than 50,000,000 kw of Westinghouse large rotating apparatus since its development in 1949. In that time the three or four coil failures experienced have resulted from mechanical causes . . . not one failure of Thermalastic insulation itself has occurred.

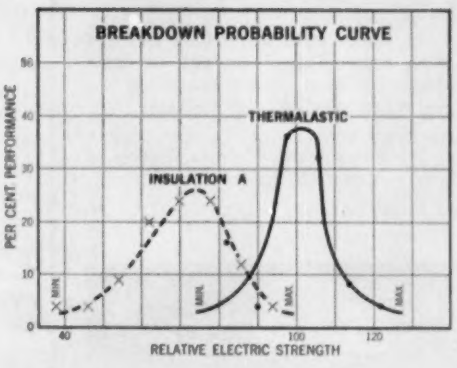
Helping to assure this outstanding performance are rigid laboratory tests which show Thermalastic insulation to be 20 times longer lived than other insulations. Tests on 4160-volt



Voltage endurance: This chart shows the results, plotted and extrapolated on a semi-logarithmic scale, of voltage endurance tests performed on several types of insulation. The combination of properties shown here by Thermalastic is unequaled—high initial dielectric strength and excellent voltage endurance.



In this destructive electric strength test, several insulated coils are picked at random. The various voltages at which failures occur are noted and plotted to form a breakdown probability curve (right). Thermalastic shows more consistent performance and at higher levels.

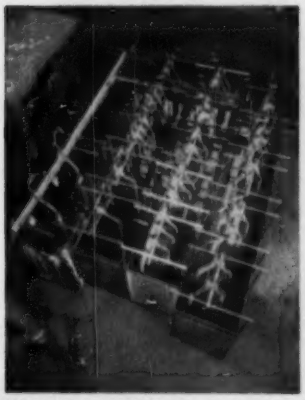


YOU CAN BE SURE...IF IT'S

tests show probable 100-year life!

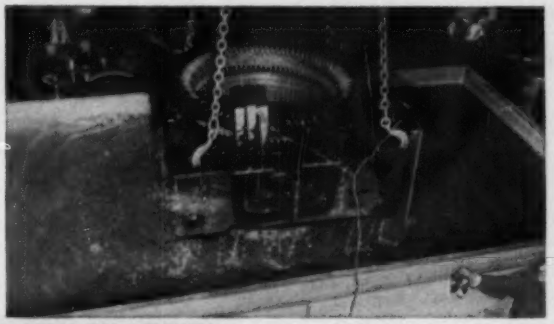
windings with Thermalastic insulation indicated a probable life expectancy of at least 100 years!

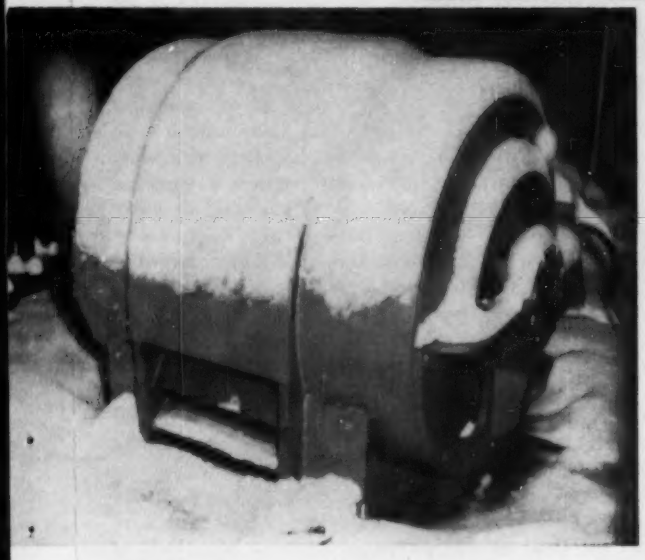
The key to this surprisingly long effective life is Thermalastic's unique molecular structure. Large overlapping mica splittings are locked in a void-free elastic bond which expands and contracts with the coil. Thus, a perfect dielectric barrier is maintained under all operating conditions, easily warding off the attacks which weaken and destroy ordinary insulation. Thermalastic is used on all F/A Motors and is another reason why the Westinghouse F/A gives you more value for your large motor investment. J-15017



Moisture resistances of various types of insulation are measured in this submersion test. Of all systems tested, Thermalastic has proven to be the most reliable system under long exposure to moisture.

Complete windings: Tests on coils do not always indicate the resistance to moisture of a complete winding. The test pictured here involves immersion of a completely wound stator. Measurement of insulation resistance showed no deterioration of any kind in Thermalastic-insulated stators.





Service tests: This conventional indoor 600-hp motor with Thermalastic insulation has been running outdoors for more than three years. Built before the F/A Motor was introduced, it has been subjected to these rigorous conditions:

- Twenty-four hours a day, five days a week, with weekend shutdowns to approach normal operating conditions.
- Summer and winter weather, with all moisture and temperature extremes.

It is still running smoothly and shows no sign of insulation breakdown or other deterioration.

COMPARE! how much costly down time has insulation failure caused in your plant!

USE THIS SIMPLE CHART TO MAKE YOUR OWN COMPARISON

	THERMALASTIC	YOUR INSULATION
Number of years	11	
Cost of repairs	0	
Hours of down time	0	

There is a Westinghouse F/A Motor to fill all your large motor needs. Call your Westinghouse representative, or write Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pa.

Westinghouse

Then Marmy did an amazing thing. He yanked a bottle of Sandpaper Gin from his pocket and crowned it with his grey bowler

Marmy's hat trick

"It gives me extreme pride, Gentlemen," beamed board chairman Franklyn T Greene of International Magnadyne Corp, "to address this first board meeting in our new . . ." but that's as far as he got.

"What the devil is that infernal noise?" suddenly cut in Ward Swafford, executive vice-president in charge of product development and research. "My ears are literally bouncing off my head."

"And my cranium feels like it's inside a Ubangi drum during a war dance," barked George Olsen, marketing research director, jumping up and clamping his well-manicured fingers over his ears.

That broke up the meeting—everyone seemed to start shouting at once. Finally, Chairman Greene sat down heavily in his upholstered chair and turned to his secretary hovering at his elbow. "Miss Brink, please call our chief engineer, Paul Mattis, up here at once." Then he glanced quickly around the large table at his annoyed colleagues and nervously lit and started puffing grimly away on a long cigar.

A few minutes later the chief engineer stepped into the spacious and elegantly appointed board room following Miss Brink. The highly waxed and polished asphalt-tile floor glistened like ice on a sunny winter day. Smooth wall partitions terminated in a luminous ceiling. And the room was comfortably air conditioned with slots running across the ceiling letting air come down from the plenum. Around the impressive board table sat the 11 board members, each with varying degrees of disgust on his face.

"Mr Mattis," blurted the board chairman when he saw the chief engineer enter the room, "this board room is supposed to be the quietest place in this new building. We spared no expense in building it, but just listen—sounds like the inside of a boiler shop working overtime. How do you account for this?"

The chief stood near the head of the table, trying respectfully to listen to Mr Greene, but unconsciously he wrinkled his brow and cocked his ears while scanning the room as if looking for some mysterious and unseen annoyer.

"I thought some of our manufacturing and office areas were a little noisy," said the chief engineer finally. "But this board room is unquestionably the most distracting executive space we have. This is the first I've known of it, though. The noise seems to reverberate in here like a ping-pong ball inside a barrel."

"My point, Mr Mattis," rasped the board chairman above the din, "is not WHAT it does, but why? How can this happen in the most modern and costly building in this part of the state?"

"For one thing," answered the chief in self defense, "I asked to have an acoustical engineer brought in at the design stage. I know that with the lighter-weight construction of these

Proved 10,000 times the world over

POWELL
PRESSURE SEAL
VALVES
Fig. 16031—New, steel pressure seal "Y" globe valve for 600 pounds.
Fig. 11365—Steel pressure seal horizontal lift check valve for 1500 pounds. Piston guided disc.
Fig. 19003—Steel pressure seal gate valve for 900 pounds.

Powell . . . world's largest family of valves

More than 10,000 Powell Steel Pressure Seal Valves are now in use all over the world—indisputable evidence they are meeting the challenge of modern industry to control constantly higher pressures at elevated temperatures. These quality, precision-built, precision tested, leak-proof valves, with exclusive features of design and construction, are available in gate, globe, angle, check patterns for 600 to 2500 W.P. and special working pressures. Many are in stock for quick delivery. Contact your nearby Powell distributor—or write directly to us.

THE WM. POWELL COMPANY • DEPENDABLE VALVES SINCE 1846 • CINCINNATI 22, OHIO

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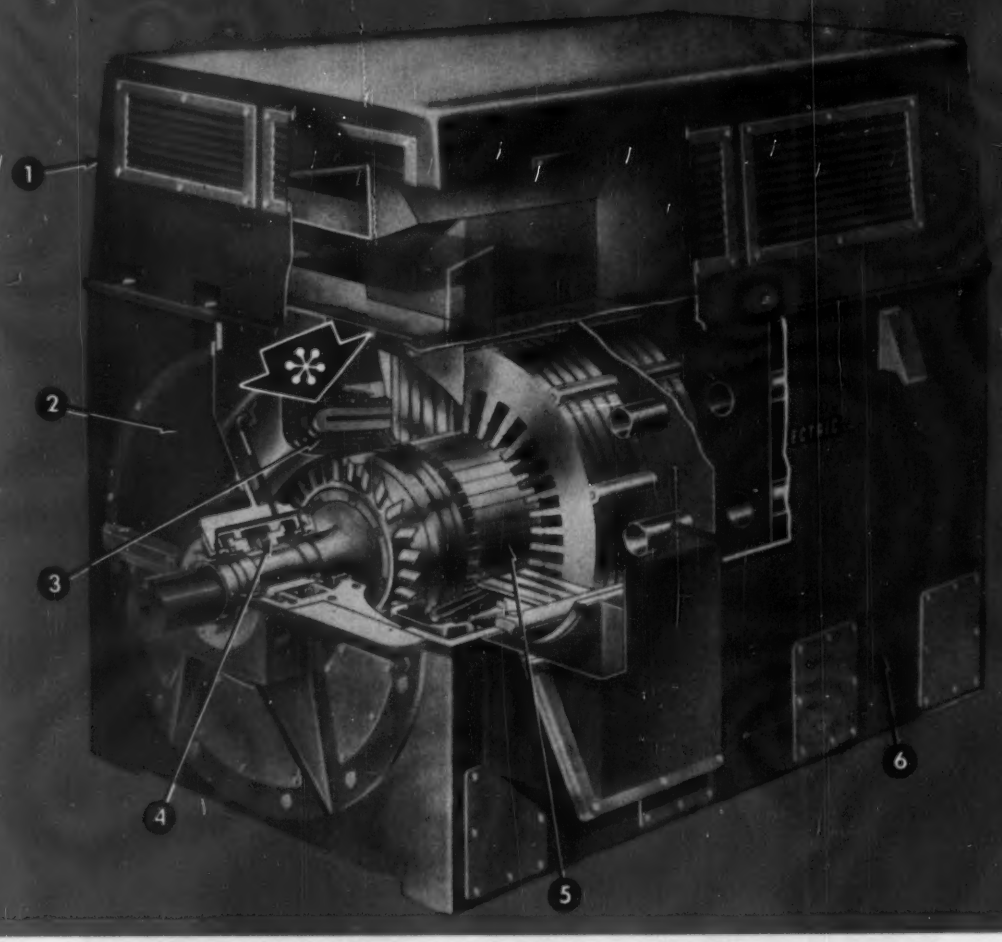
NEW General Electric CUSTOM '8000' Boiler Feed Pump Motors . . .

CUSTOM DESIGNED FOR POWER STATION APPLICATIONS



1 REMOVABLE "TOP-HAT" provides easy access to motor interior. Top-hat is baffled and lined with sound absorbing materials to attenuate motor operating noise. Rotor and stator are constructed to reduce noise and direct sound waves into the acoustically treated top hat.

2 NEW END SHIELD DESIGN reduces time required for inspection and maintenance. One man can quickly unbolt and lift off the upper end shield half and remove the split air deflector. Bearing support is integrally cast with the lower end shield. Lower half of bearing can be "rolled out" for inspection without removing end shield.

3 EXCLUSIVE POLYSEAL* SUPPORTED SILICONE RUBBER INSULATION SYSTEM provides superior mechanical, thermal, voltage and environmental endurance—affords top reliability in critical Electric Utility applications.

4 TRIPLE PROTECTED BEARING SYSTEM lengthens boiler feed pump motor life. A primary seal is formed by the ring mounted on each end of the bearing shell and adjacent oil slinger machined in the shaft. A multiple groove seal at each end of bearing housing acts as a second line of defense against dirt entrance and oil leakage. In addition to the slingers and close running labyrinth seals, G.E.'s new bearing system utilizes an *Air-Lock* seal in each bearing housing. Air at slightly higher than atmospheric pressure is piped to annular grooves at each end of the bearing. This air pressure acts as a third seal to keep oil locked in the bearing housing.

5 ROTOR PARTS ARE MACHINED TO PRECISION TOLERANCES and assembled using especially developed techniques to assure high-speed operational stability.

6 RUGGED FRAME ASSURES SOLID STRUCTURAL SUPPORT for stator, end shields, rotor and top-hat. Frame is precision machined to positively align motor parts.

GENERAL ELECTRIC'S "CUSTOMIZED" MOTOR manufacturing philosophy permits the design flexibility, and the adherence to quality control production standards, which assure Electric Utilities of optimum motor performance, reduced operating costs and lower first cost. In keeping with requirements of Electric Utilities, Custom '8000' boiler feed pump motors are available now in ratings to 10,000-hp. 883-01

* Trade-mark of General Electric Co.

Progress Is Our Most Important Product

GENERAL ELECTRIC

For more facts circle 295 on Reader Service card, p 103

NEW

encapsulated connection harness increases mechanical strength, assures maximum motor reliability

General Electric's new encapsulated connection harness consists of two rings of insulated conductors encapsulated in epoxy resins. The larger ring contains motor leads and phase connections, while the smaller ring contains equalizer connections.

This new system provides greater strength and rigidity at the end turns and assures uniform coil connections. Rigid encapsulation prevents contact between conductors—eliminates insulation abrasion. The epoxy compound provides additional insulation for leads and connections.

NEW ENCAPSULATED CONNECTION HARNESS for General Electric boiler feed pump motors provides an immobilized connection bundle . . . eliminates loose ties and abraided insulation.

YOUR GENERAL ELECTRIC APPARATUS SALES REPRESENTATIVE has full details on new G-E boiler feed pump motors. Call him today. Medium AC Motor & Generator Department, Schenectady 5, N.Y.

Progress Is Our Most Important Product

GENERAL ELECTRIC

Marmaduke

Begins on page 150

modern buildings with new types of interior partitions, all kinds of mechanical equipment can create noise-control problems. But, perhaps, you gentlemen recall that I was turned down flat. Yet I must admit that I did think this board room wouldn't be so noisy. I'm sure we can do something."

Next day the contractor who installed the air-conditioning equipment sent his ace troubleshooter to visit the International Magnadyne Corp. The new 400-ton centrifugal compressor type air-conditioning unit in the penthouse seemed fairly quiet. But the troubleshooter, accompanied by the chief, traced every foot of the ductwork down to the board room.

"No question in my mind that the slight compressor and fan noises do carry through the ductwork into here," opined the contractor's man after some deliberation. "This seems to be our main problem."

"Yes, that's obvious, but what'll you do?" asked Mr Mattis impatiently.

"We'll install sound-absorbing attenuators made of a cylindrical metal sleeve of the same material and thickness as the discharge ductwork of the high-pressure conditioning supply fan," answered the contractor's man. "We'll line the attenuators with 2-in.-thick fiberglass wool covered with glass cloth. I'm sure that will quiet her down."

But after these changes were made the board room was still too noisy. Some nasty arguments began among the chief engineer, the contractor and the air-conditioning manufacturer. Finally, someone in the engineering department persuaded Mr Greene to call a Marmaduke Surfaceblow, consulting engineer.

Long-distance calls to his office in the Hell's Kitchen section of New York City were of no help. Then a telegram was sent to the Bent Propeller Bar around the corner from O'Houlihan's Machine Shop and Engine Works. Marmaduke received the message there one evening just as he was in the serious act of ballasting his deep tanks from a bottle of Sandpaper Gin.

Two days later as a freight train slowed down at the railroad siding

Catawissa PERFECT SEAL *Unions*

HOT FORGED from solid, rectangular steel bars, designed and produced for dependable, long-life service under the severest piping conditions!

A TYPE FOR EVERY USE!
FOR ALL PRESSURES!
FOR ALL TEMPERATURES!

Standard & Double Extra Heavy UNIONS
Available with screwed or socket weld ends. 3000-lb. sizes ⅛" to 3"; 6000-lb. sizes ⅛" to 2".

GASKETLESS CUP-ORIFICE UNIONS
Choice of stainless or carbon steel cup-type plate. 3000-lb. service.

MALE & FEMALE UNIONS
With steel-to-steel, bronze-to-steel, stainless steel-to-steel or orifice seats. 3000-lb. service only.

FULL STAINLESS & FULL ALLOY STEEL UNIONS
With screwed or socket weld ends. 3000-lb. and 8000-lb. service.

Write for Catalog 60
Showing the Complete Catawissa line of Perfect Seal Products

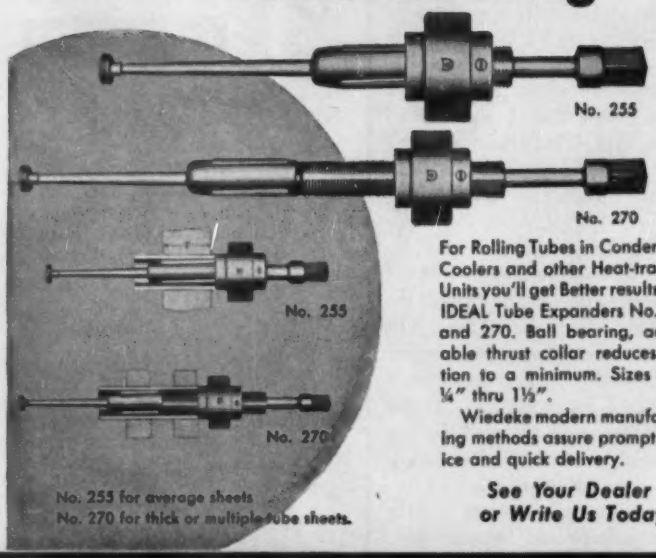
CATAWISSA VALVE & FITTINGS COMPANY
CATAWISSA, PENNA.

circle 296 on Reader Service card, p 103

IDEAL

Precision-Built for faster, smoother

Tube Rolling



For Rolling Tubes in Condensers, Coolers and other Heat-transfer Units you'll get Better results with IDEAL Tube Expanders No. 255 and 270. Ball bearing, adjustable thrust collar reduces friction to a minimum. Sizes from ¼" thru 1½".

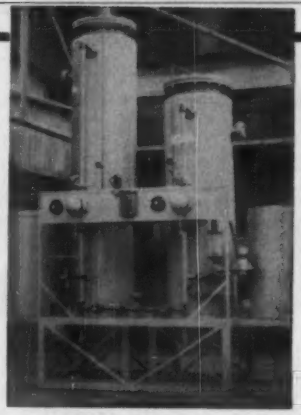
Wiedeke modern manufacturing methods assure prompt service and quick delivery.

See Your Dealer or Write Us Today!

The Gustav WIEDEKE Company

DAYTON 1, OHIO

For more facts circle 297 on Reader Service card, p 103



NEW FROM H&T

Low-Cost • High-Performance

"PACKAGE" DEMINERALIZERS!

TWO-BED and UN-A-BED STANDARD UNITS

NOW AVAILABLE!!

Unless *special* conditions require you to use a *special* demineralizing system, you can save big money—and get excellent results—with the new H&T Standard "PACKAGE" DEMINERALIZER! Into these superior Standard Units, we've put the experience of 16 years in building many hundreds of manual and automatic demineralizing systems. *Result:* H&T "PACKAGE" DEMINERALIZERS are masterpieces of design and construction—unequalled in performance and wonderfully low in cost.

Write for details of Two-Bed and Un-A-Bed Demineralizers

H&T SERVICE

HUNGERFORD & TERRY, INC.

CLAYTON 3, NEW JERSEY

For more facts circle 298 on Reader Service card, p 103

Marmaduke

Begins on page 150

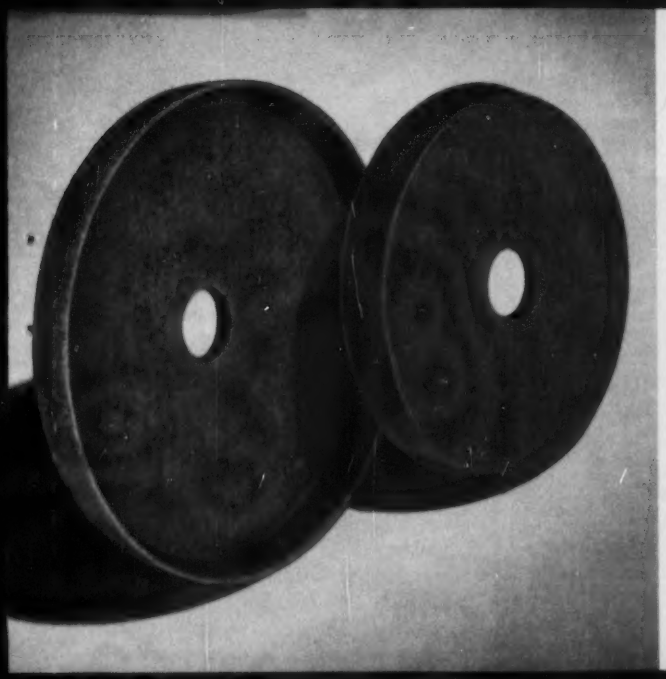
of the International Magnadyne Corp, a husky, 6-ft 4-in. individual swung gracefully to the ground from the moving caboose. Any observant person could tell that such a skillful exit from the shelter of the N.Y. Central RR's rolling equipment came only from years of experience.

The somewhat unusual-looking character wore a battered grey bowler cocked jauntily to one side of his massive head. He was dressed in tweeds and sported a checkered vest. Marmaduke Surfaceblow called over his shoulder to the brakeman, "Thanks, George—see you tomorrow going East." Then he leisurely lit an evil-smelling cigar that he fished from a vest pocket, looked quickly around and headed directly for the power plant under the smoke stack of the new factory.

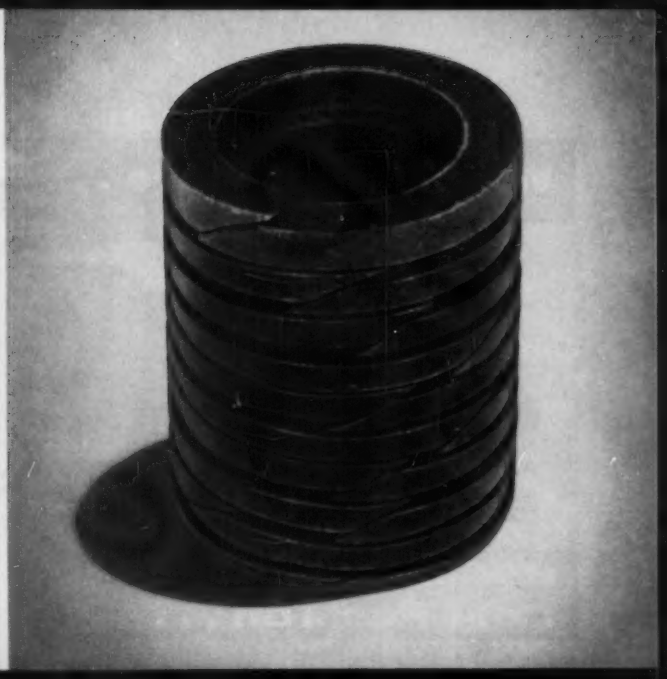
What conversation took place in the power plant a few minutes later between Mr Surfaceblow and his contact will forever be lost to posterity. But we do know that an hour later, at exactly 10:17 am, Marmaduke Surfaceblow entered that holy of holies—the board room—accompanied by chief-engineer Mattis. But the board room was not unoccupied. Mr Greene and several board members sat rigidly around the table. There also was a local architect who seemed to be a friend of the board chairman. The architect was talking agitatedly to Mr Greene.

". . . Of course, there is a certain amount of natural attenuation in duct systems. Most of this attenuation is in the form of reflections set up by elbows and branch fittings which, rather fortunately, are most effective for low-frequency sound and for small sizes of ducts. As a result of this reflective effect. . . ."

At this point all present observed Mr Surfaceblow walk slowly about the room, squinting up at the overhead with a somewhat quizzical look on his unshaved face, as if he had already detected something fishy. Then he did an amazing thing. He yanked a half-filled bottle of Sandpaper Gin from his hip pocket and placed it gently in the center of the huge board-room table. Whisking off his grey bowler, he crowned the bottle with it; then he removed a long



Anchor Style No. 1152-TA Cups



Anchor Style No. 1110-TA Packing Rings and Sets

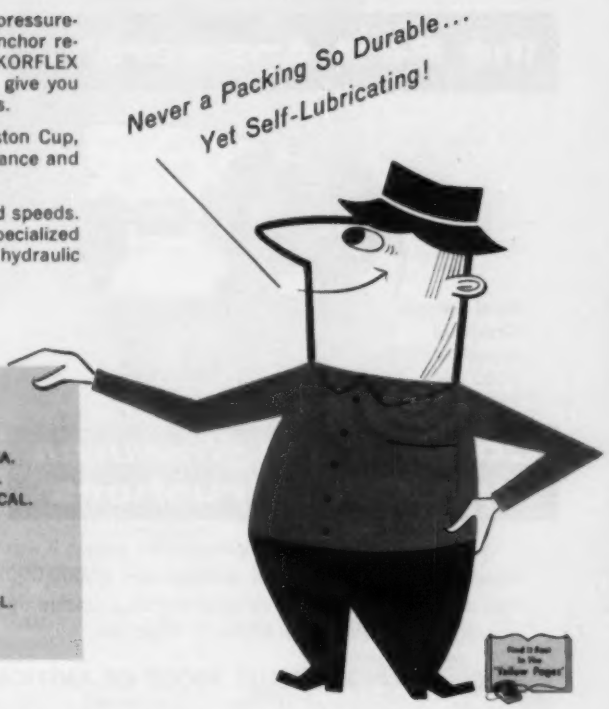
ANCHOR now unites two great materials... versatile ASBESTOS and miracle ANKLON!*

If you are an ANKORFLEX user, you know how successful these pressure-sensitive rings are in pneumatic and hydraulic services. Now Anchor research has gone one step farther—combined the versatility of ANKORFLEX with the heat-resistant, self-lubricating qualities of ANKLON—to give you Anchor Style No. 1110-TA designed for the most difficult conditions.

Similarly, Anchor research has developed Ankorite Asbestos Piston Cup, Anchor Style No. 1152-TA, in which ANKLON with its heat resistance and self-lubrication qualities is incorporated.

Both products perform perfectly under high or low pressures and speeds. Available in various sizes for extremely difficult and highly specialized services against air, gases, chemicals, solvents and new type hydraulic fluids—at temperatures 500° F. and higher!

*made from duPont's Teflon



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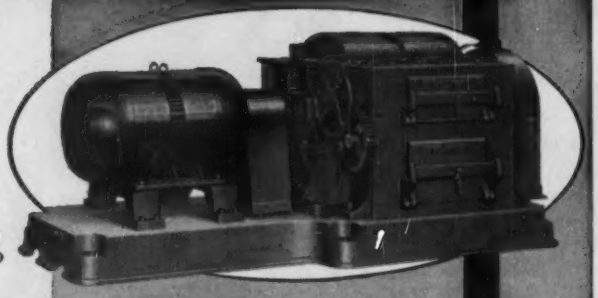
GENERAL OFFICES . . . PHILADELPHIA, PENNSYLVANIA
FACTORIES . . . MANHEIM, PA., ELKHART, IND., MONTREAL, CAN.

FIBROUS AND METALLIC PACKINGS FOR EVERY INDUSTRIAL PURPOSE

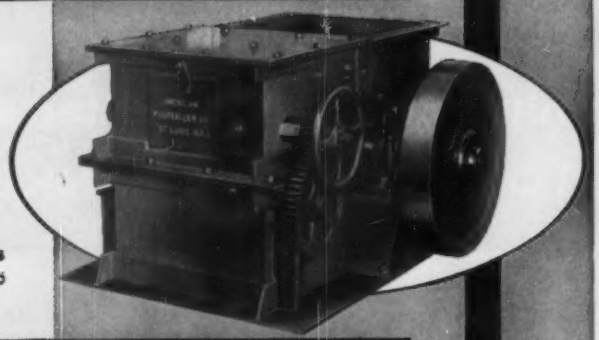
For more facts circle 299 on Reader Service card, p 103

When You Figure . . .



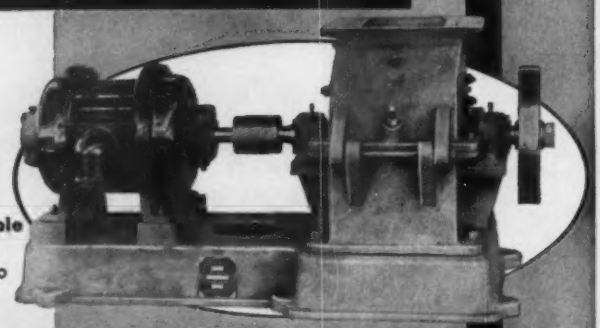
AC Series
capacities to
800 TPH

Reduction
Cost Per Ton . . .



WC Series
capacities to
90 TPH

the Best Answers*. . .



Coal Sample
Crushers
capacities to
2000 Lbs.
Per Hr.

Come from American
Ring Coal Crushers

*In a recent independent survey, it was found that American Crushers reduced over 61,000,000 tons of coal at a parts replacement cost (including standby parts) of less than 1/10th of 1¢ per ton.

THERE CAN BE NO BETTER PROOF OF AMERICAN QUALITY!

American
PULVERIZER COMPANY

WRITE for Literature on These Crushers

1349 MACKLIND AVE. • ST. LOUIS 10, MO.

For more facts circle 300 on Reader Service card, p 103

Marmaduke

Begins on page 150

black cigar from his vest pocket.

After extracting a large wooden match and striking it on his thumbnail, he revved up his induced draft fan and inhaled deeply. With his cheeks puffed out like the north wind's shown on ancient mariners' maps, he leaned over the table and blew the smoke under his bowler. He quickly fell to one knee to observe the pumping action of the smoke as it floated haltingly heavenward from beneath his hat.

This operation and the appearance of the stranger were so unusual that the architect stopped talking. He evidently realized that no one was listening to him anyway. Everyone was agog, with eyes glued on Marmy, watching his mysterious movements. Then as suddenly and unexpectedly as a jumping jack-in-the-box, Marmy bolted upright and roared in his foghorn voice, "BILGEWATER on attenuation and all that subharmonic sinusoidal frequency stuff. Your trouble is that this modern steel table acts like the sounding board of a piano. It amplifies the little mechanical-vibration and air-passage noise that comes in here—to say nothing of all the high-powered racket that's generated inside this room when the top brass sound off. And because your floor, walls, and ceiling are hard and parallel to each other, this table bounces the noise back and forth like a boxer does a punching bag. That's why this is the noisiest room in the building. All you have to do is put in a thick wall-to-wall carpet, build a fifth leg in the center of the table, then put rubber, felt or glass-wool isolation pads under each table leg. That'll stop the table from acting like a step-up transformer for noise."

Having thus spoken, Mr Surfaceblow reached for his hat and set it at a cocky starboard list atop his unruly wiry hair. Then he reached for his bottle and bellowed . . . "There's a slight matter of a thousand-dollar consulting fee, plus one hundred and seventeen dollars and nine cents for expenses before I leave." Everyone was too dumbfounded to utter a word.

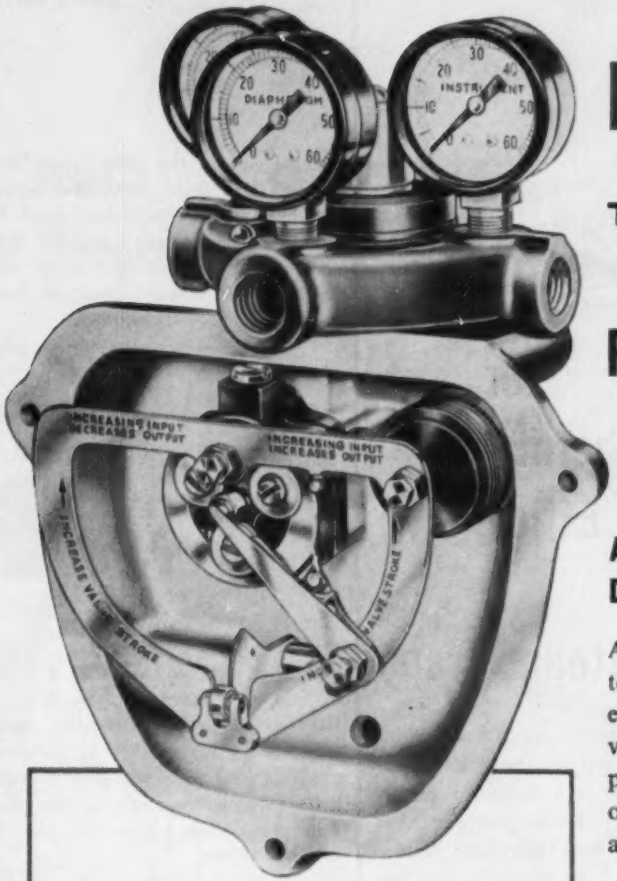
For our readers' information—Mr Surfaceblow's recommendations were

A new concept in design makes possible the...

FISHER

TYPE 3560 VALVE POSITIONER

V/P



Assured product performance through DYNAMIC ANALYSIS engineering

Application of mathematical techniques of design to pressure control systems has enabled Fisher to eliminate the conventional approach in the development of the new V/P valve positioner. It has provided the V/P with the following combination of characteristics and performance . . . unobtainable in any other type of valve positioner.

SMALL AND COMPACT . . . only 6⅜" wide and 8¾" high (with gauges).

CONVENIENT ADJUSTMENT . . . valve stroke and zero adjustment readily accessible and easy to make.

SPLIT RANGE . . . no parts change whatsoever is required for split range operation.

EASILY REVERSIBLE . . . reversed by simply moving flapper arm from one beam quadrant to the opposite quadrant.

CHARACTERIZED CAMS . . . offer wide flexibility in valve characteristics.

PERFORMANCE DATA

Hysteresis, (Average)	0.0012"
Linearity	as required. Change cams to obtain desired characteristics
Sensitivity	0.14 psi
Resolution Sensitivity	0.002 psi
Repeatability	±0.0003"
Stroking Speed	0.37 in/sec.
Air Consumption	10 scfh
Break Frequency (5% of instrument pressure range)	3.9 cps
Break Frequency (3% of instrument pressure range)	4.6 cps

The above performance data was taken from laboratory tests on a Type 657 diaphragm actuator, Size 40, with 1½" travel. Instrument range 3 to 15 psi.

Write today for Bulletin E-3560

IF IT FLOWS THROUGH PIPE ANYWHERE IN THE WORLD . . . CHANCES ARE IT'S CONTROLLED BY . . .

FISHER GOVERNOR COMPANY

Marshalltown, Iowa / Woodstock, Ontario / Rochester, England

BUTTERFLY VALVE DIVISION: CONTINENTAL EQUIPMENT COMPANY, CORAOPOLIS, PA.

FISHER® Controls

SINCE 1880

Nicholson Thermostatic Steam Traps

These traps are only a fraction of your steam equipment cost . . . yet they can do a whale of a job in helping you to get full efficiency from that equipment even with varying pressures. Here's how.

Operating on a true balanced vapor-pressure principle, they discharge air, condensates and other non-condensables promptly, fully and intermittently. What's more, the bellows is located where it belongs . . . at the trap top . . . so that when live steam enters it contacts the bellows the moment the discharging condensate falls below the top of the inlet pipe. Thus, there is a constant water seal to prevent loss of live steam. This, plus the fact that valves and seats are accurately lapped for sure, safe shut off assures you of full thermal efficiency from every pound of steam. Capacity? These traps have it . . . up to six times greater than ordinary traps. Also since there's only one moving part . . . no links, pin, levers . . . your maintenance cost is next to nothing.

Get maximum Thermal efficiency from your equipment. Specify Nicholson Thermostatic Steam Traps. Immediate delivery.

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12 Oregon St., Wilkes-Barre, Pa.
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12 Oregon St., Wilkes-Barre, Pa.
Please send a copy of Catalog #400
NAME_____
COMPANY_____
STREET_____
CITY_____ STATE_____

Begins on page 150

carried out to the letter—and they worked. He received his check promptly and we understand the N.Y. Central RR was once again the benevolent but unknowing host to our hero on his sojourn back to New York City.—STEVE ELONKA

Marmy's mailbox

LONG-TIME FAN

For a long time I've been a Marmaduke fan. Several of us here at Burson - Marsteller Associates look forward to his stories in between grinding out advertising and publicity on power equipment. Now that I have his book I can read his adventures at ease.

H A BERGEN, *Chicago, Ill.*

MARMY CLEVER

To say that the Marmaduke stories are very clever and well written is an understatement. Personally I think they are the best stories of their kind I have ever read.

T CRANE, *Hamden, Conn.*

REMEMBER OLD DAYS

Marmy's Lit Piston in Sept 1959 reminds me of my own experiences—my first power-plant job was in 1907. On that job, the piston of a large air compressor came loose. I told the super, but he ordered me to keep the compressor running. That watch the head blew out; he got fired. Many is the time I detected a loose part in reciprocating machinery—but I always shut down immediately, have never had trouble.

H LIVINGSTON, *Los Angeles, Calif.*

MARMY HAS TALENT

The way that old 2-fisted seagoing engineer Marmaduke solves engineering problems, year after year, is

For more facts circle 303 on Reader Service card, p 103

circle 304 on Reader Service card, p 103 ➤

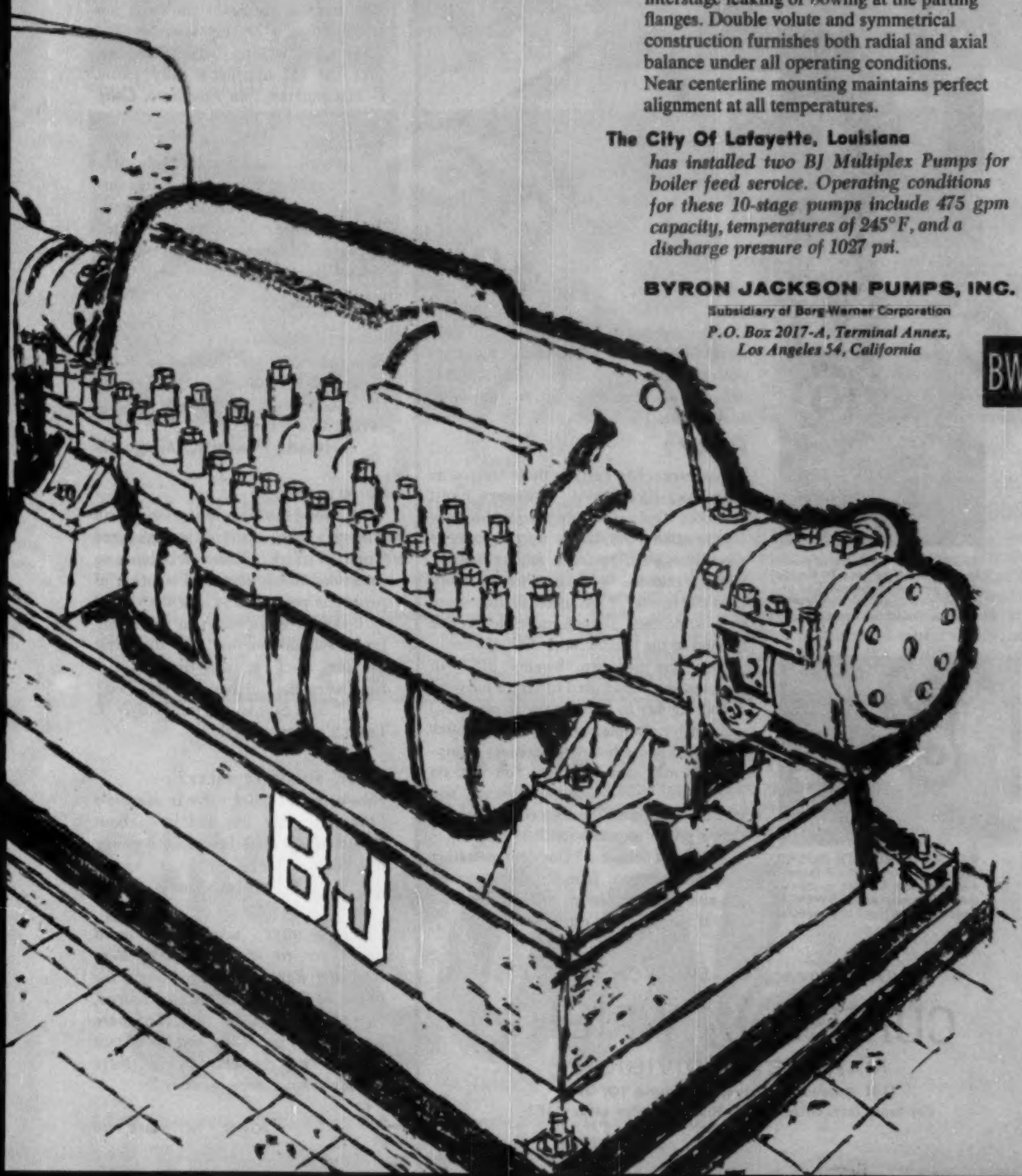
Quality *costs less* in the long run!

BJ Multiplex Pumps

For high pressure, high temperature and high speed pumping, an extra safety factor is built into this DVMX Pump—*the safety of a quality product!*

Clean and compact, BJ's advanced design allows double-row bolting to prevent interstage leaking or bowing at the parting flanges. Double volute and symmetrical construction furnishes both radial and axial balance under all operating conditions. Near centerline mounting maintains perfect alignment at all temperatures.

The City Of Lafayette, Louisiana
has installed two BJ Multiplex Pumps for boiler feed service. Operating conditions for these 10-stage pumps include 475 gpm capacity, temperatures of 245°F, and a discharge pressure of 1027 psi.



BYRON JACKSON PUMPS, INC.
Subsidiary of Borg-Warner Corporation
P.O. Box 2017-A, Terminal Annex, Los Angeles 54, California

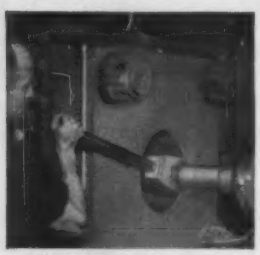
BW

the **SWENCH®**

LOOSENS TOUGH NUTS
THAT EVEN POWER
TOOLS CAN'T BUDGE

WHEEL LUGS on buses and trucks usually require the "beef" and skinned knuckles of two men to loosen. SWENCH does the job faster at less cost.

Discard that old-fashioned sledge. Put your torch away. Think before you buy another power wrench. Here's a *manual* wrench that delivers more effective torque than any other tool its size.



FROZEN HEX NUT on this molding machine caused 36 hours down time when removed by ordinary methods. Just 7 SWENCH impacts moved this tough baby.

HOW?

Power wrenches deliver their torque as many tap-like blows. Ordinary hand wrenches apply a steady torque. Swench, on the other hand, builds up power in its super-strong spring for a mighty wallop, which is released as torsional impact every time the handle is advanced slightly more than 30 degrees. Swench multiplies torque applied to the handle more than 15 times.

Now one man can "Swench off"—in minutes—nuts that used to take a full crew a working day to burn or sledge off.

Swench is completely portable. No power connections needed. No auxiliary equipment to man and maintain. You save on man-hours. You save on maintenance. You save on initial cost. (Swench costs *much less* than a power impact wrench.)

You don't believe it? One demonstration will convince you. Line up your toughest job and give your Industrial Distributor a call. If Swench can't do it, no tool can.

RAILROAD HOPPER DOORS easily rust shut. Often it takes a 4-man crew a full day to loosen them. One man and a SWENCH does the job in just 7 or 8 impacts.

Don't wrench it—SWENCH IT!

CURTISS WRIGHT

MARQUETTE DIVISION

1141 Galewood Drive, Cleveland 10, Ohio

For more facts circle 305 on Reader Service card, p 103

Marmaduke

Begins on page 150

darned interesting. I don't know of any engineer who has as much talent as that old sea dog.

R E LEONARD, *St. Paul, Minn.*

ANOTHER FAN

Ever since we received a copy of *The Marmaduke Story*, my wife has also become a Marmy fan. She has done some writing herself, and enjoys the old mariner's salty yarns.

G TIMMERMAN, *San Francisco, Calif.*

EDUCATIONAL

Along with a good many of our other POWER readers here at Westinghouse Electric, I enjoy the many Marmaduke episodes. They are both interesting and educational. The old consultant has many friends here.

R V MCGAHEY, *Pittsburgh, Pa.*

LIKES MEN—TOO

Enjoyed *Marmy's continuous monitor* in Feb 1960 issue. Liked the hero, the cat, because purple cats are my favorite—after men.

HELENA WARWICK, *Chicago, Ill.*

CAN'T PROOFREAD

I proofread the Marmy stories and all POWER's other material at Blanchard Press, N. Y. C. Today I became so interested in his perennial solution of problems presented to him that I had to make an extra effort to catch any typographical errors on the first reading. Tell me, was there ever a time when the old boy was stumped?

M E SUSSMAN, *Plainfield, N. J.*

EDITOR'S NOTE: NO!

WHAT, NO RELIEF VALVE?

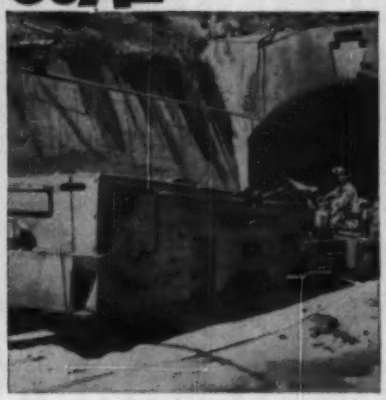
How come no relief valve in *Marmy's little drip*, July '59, and how about circuit breakers or fuses in the power line to the motor?

J DEHAAS, *Seattle, Wash.*

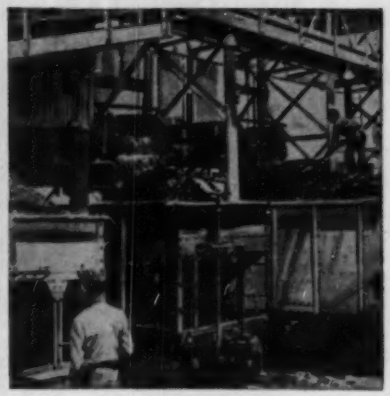
EDITOR'S NOTE: *when we showed this letter to Marmy at the Bent Propeller Bar, he slammed down his bottle of Sandpaper Gin and roared, "*BILGEWATER *on that stuff. Had there been a relief valve and had the circuit breaker and fuses worked there wouldn't have been a story."*

BEACON COAL HAS WHAT IT TAKES

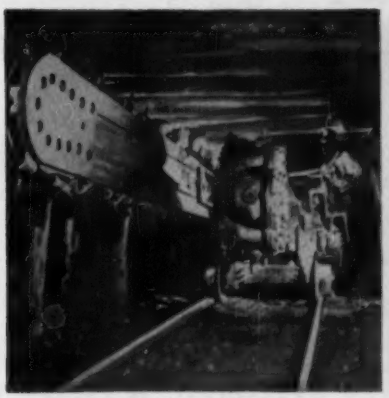
MEN



MINES

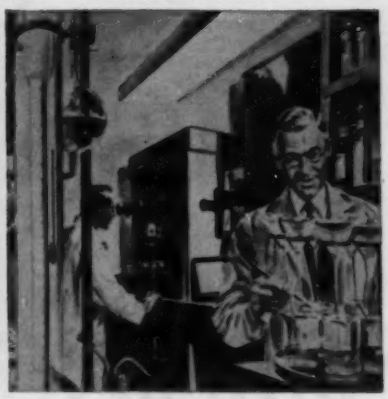


CAPACITY



EQUIPMENT

PREPARATION



QUALITY CONTROL

To give the electric utility industry the coal, the assurance, and the service it needs

Next time you write the specifications for the kind of *coal* you want, why not jot down the specifications of the kind of *supplier* you would like to have . . . and see how we measure up!

We have been serving electric utilities for many years, and feel that we know intimately their needs and problems. Our 15 mines provide a variety of coals, and a potential that can deliver up to 15 million tons a year at need. Modern mechanization plus skilled miners equip us to gear production to virtually any emergency you might encounter, and mine location on a number of major railroads gives wide latitude in routing. We maintain close check on quality in our laboratories. Our representatives are men who have made coal their life work and the serving of customers their highest aim. Finally, our past record, if you care to check it, provides complete assurance that you will get the coal you want, when, where, and as you want it.

EASTERN GAS AND FUEL ASSOCIATES

PITTSBURGH • BOSTON • CLEVELAND • DETROIT • NEW YORK
NORFOLK • PHILADELPHIA • SYRACUSE

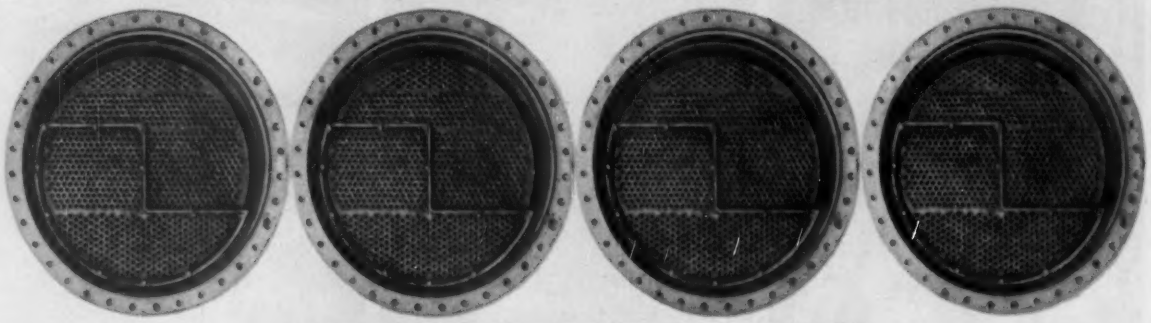
For New England: New England Coal & Coke Co., For Export: Castner, Curran & Bullitt, Inc.

BEACON COAL

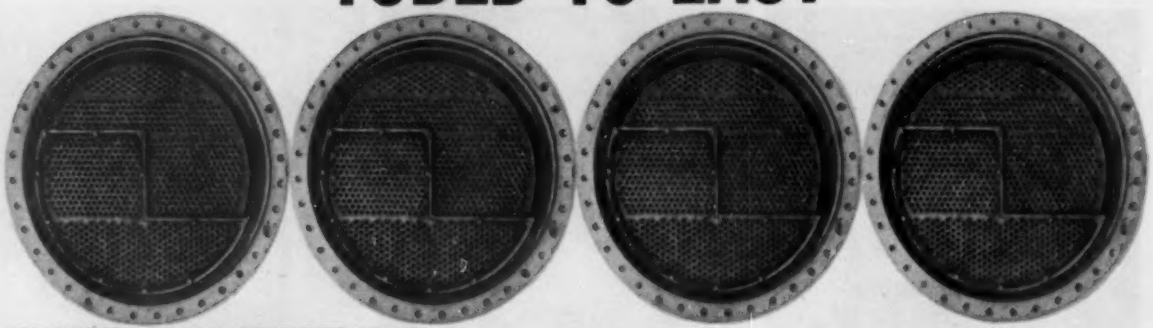
EASTERN GAS AND FUEL ASSOCIATES — BEACON COAL

For more facts circle 306 on Reader Service card, p 103

8 MORE FEED WATER HEATERS



"TUBED TO LAST"



WITH REVERE 70/30 Cupro-Nickel Tubes

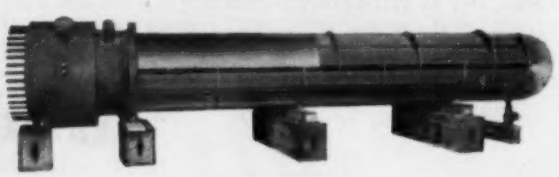
These Units for Cherokee Station Unit #2 of Public Service Company of Colorado were fabricated by YUBA Heat Transfer Division, YUBA Consolidated Industries, Inc., Honesdale, Pa.

Because there are so few sets of operating conditions that are exactly alike, each tube installation poses its specific problem which must be studied before a satisfactory recommendation can be made. In this installation of 8 feed water heaters, the specific set of conditions called for dual gauge tubes of 70/30 Cupro-Nickel. Tubes of dual gauge were used in order that uniform wall thickness be maintained after bends had been made.

This selection was made as a result of the collaboration of YUBA Engineers and Revere's Technical Advisory Service. It is this Revere Service, with its experience covering many and varied types of problems, that has been instrumental in prolonging tube life in power plants both large and small.

Why not take advantage of this storehouse of knowledge and contact Revere before making the final selection of tubes and plates for your equipment?

8 TUBE BUNDLES like this consumed 47,000 lbs. of Revere 70/30 Cupro-Nickel Dual Gauge Tubes.



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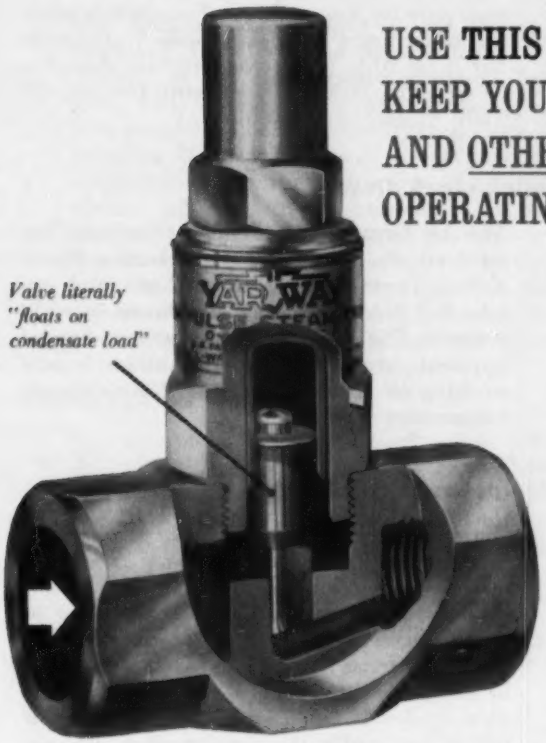


Valve literally "floats on condensate load"

USE THIS YARWAY STEAM TRAP TO KEEP YOUR DRYERS, COOKERS, TANK COILS AND OTHER PROCESSING EQUIPMENT OPERATING AT PEAK EFFICIENCY

Yarway Series 60 Impulse Steam Traps are the traps "designed with high production in mind." They get processing equipment hotter, sooner—and keep it hot. Here's how:

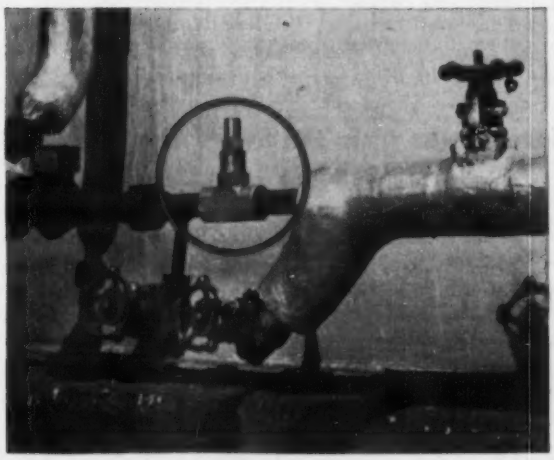
The only moving part, a small stainless steel valve, literally "floats on the condensate load." When equipment is started up, and condensate load is heavy, it opens wide and discharges at full capacity to bring equipment to operating temperature as quickly as possible.

In operation, it continuously senses condensate temperature, discharging each bit of condensate as it forms instead of storing up a bucketful. Result—higher temperatures, more even temperatures, more productive equipment.

Other Yarway features—small size, light weight, good for all pressures, low maintenance, stainless steel.

Yarway pioneered the impulse trap with its unique thermo-dynamic principle over 25 years ago. Most users find among Yarway's full line of impulse traps the profitable and productive solution to their steam trapping problems—you can too!

You can get Yarway's latest steam trap Bulletin T-1743, or a free 60-day trial of any Yarway Steam Trap, by writing Yarnall-Waring Company or contacting your local Industrial Distributor.



¾" Yarway Impulse Steam Trap draining tank coils on sulfur storage tank, 175 lbs. pressure

YARWAY OFFERS IMPULSE STEAM TRAPS FOR THESE SPECIFIC OPERATING CONDITIONS

AVERAGE CONDENSATE LOADS	EXTRA HEAVY CONDENSATE LOADS	LIGHT CONDENSATE LOADS
Series 60	Series 40	No. 30

For more facts circle 308 on Reader Service card, p 103

Powerscope . . . A selective look at

Columbia River project

Canadian and American negotiating teams have agreed on terms to be written into a treaty governing joint development of the waters of the Columbia River basin. Development will cost three to four billion dollars and boost output of the Columbia's hydro plants by about 9000 mwhr. Plan involves building storage reservoirs in Canada, sending half the power increase realized from such storage in U.S. plants back to Canada as their share. Treaty will be drafted soon to implement the plan. With early ratification, work could start as soon as 1961. *(McGraw-Hill World News)*

Japan offers electrical gear

NGK Corporation of Japan has submitted a bid to TVA to supply 28,500 insulator units for $72,135—more than 20% below the lowest American bid of $92,625 by H K Porter of Lisbon, Ohio. The low Japanese bid was evaluated according to the Buy American Act which adds 6% to foreign bids. If the American firm is in a surplus labor area 12% is added. By law TVA must buy from the lowest bidder after these adjustments are made. Several congressmen have protested TVA's awarding previous turbine-generator contracts to British and Swiss firms as unfair competition. ***(McGraw-Hill World News)***

Highest high-line starts working

Pennsylvania Electric Company placed the first 460-kv line in network operation in the U.S. on Sept 30th. This matches the highest voltage in operation anywhere in the world today. Tests have shown the line can run as high as 505 kv. The 13-mile 3-phase line has a rating of 60 mva. The record line uses record equipment: the highest-rated lightning arresters, highest-rated power transformer in terms of voltage, highest-rated disconnect switch and newest types of insulator assemblies.

New Edison Electric Institute booklet

"Power and progress," published by the EEI, shows that the U.S. has three times the electric capacity of the U.S.S.R. At the end of 1959 U.S. had 175,000, U.S.S.R. only 59,000 mw. With only about 1/16th of the world's people the U.S. has more than 1/3 of all the world's electric-power capacity. This means we have 985 watts per person while the rest of the world averages only 120 watts per capita. The 36-page booklet, written for the layman, gives the history of the industry and its potential for the future. Single copies are free; you can buy it for 20 to 50c per copy in bulk, depending on quantity. Write Edison Electric Institute, 750 Third Avenue, New York 17, N. Y.

Quick-start diesels

The Air Force Base at Thule, Greenland has received six diesels from Fairbanks, Morse & Co. These units develop 12 mw and can take full load from cold shutdowns in eight seconds. The engines are turbosupercharged opposed-piston diesels. The builder is now working on standby units for Polaris atomic submarines.

Mexico acquires utility

Mexican Government has taken official control of Mexican Light and Power Company. Executives of company were released from their positions by the Mexican Government, which will appoint its own management. The utility produced more than 40% of Mexican electric power. It was bought by stock deals for $56 million. Money mostly came from Prudential Life Insurance Company's $100-million loan earlier this year. Same money was also used to buy out American and Foreign Power utilities several months ago. Mexico's President Mateos says new law is being enacted to prohibit any future electric production in the country by other than government-owned plants. *(McGraw-Hill World News)*

More power from the Swiss Alps

Over 30 rivers high in the Alps will be linked by a 57-mile network of tunnels to ultimately produce about 1,600,000 mwhr annually. A 935-ft-high dam will store enough water to generate 1,400,000 mwhr during winter months when the river system normally freezes over. The Grande Dixence project gathers water from the valley of Zermatt and slopes of the Matterhorn on the east to the Val-des-Dix on the west, spanning a considerable part of the Alps bordering on Italy. Several dams on the system are the highest above sea level in the world; top of the new large dam will be 7760 ft above sea level.

this month's power-field happenings

B G A SKROTZKI, Associate Editor

NEMA meets in New York City

The 34th annual meeting of the National Electrical Manufacturers Assn will be held Nov 17 at the Savoy Hilton Hotel in New York City. Admission is by invitation only to a program highlighted by a symposium of scientists discussing research and its practical implications for the industry. The newly elected officers will be announced at the luncheon and awards presented to three top member-company executives for outstanding contributions to the industry. Division and product-section meetings will precede the annual meeting at other places and cities.

Hands across the sea

Two representatives of the National Science Foundation have been assigned to the American Embassy in Tokyo, Japan to assist in exchange of scientific knowledge between scientists and institutions in Japan and the U.S. These men will act as an integral part of the Embassy. They will study and report on organization and funding of Japanese science and make similar data on American science available to the Japanese.

More fuel-cell activity

The Battelle Memorial Institute has started a fuel-cell-technology research program to complement existing government, industrial and academic studies. Major American and European industrial organizations including public utilities, chemical, petroleum, transportation, mechanical-equipment and engine and automotive manufacturers are supporting the program.

New studies on transmission

Pacific Power and Light Co and Westinghouse Electric Corporation announce that their studies show electrical energy can be transmitted over distances as long as 1000 miles. Distances and voltages now being studied in research are higher than anywhere in the world. Tensions up to 690 kv and 3000-mw capacities were studied. *(McGraw-Hill World News)*

FPC reports electric bills

The Federal Power Commission in its periodic studies of electric bills reports that the average electric bill for residences in the U.S. was $7.44 per month for 250 kwhr consumed as of January 1, 1960. In 1951 it was $6.95 and in 1935 $8.91. The average bill for commercial light service last January was $28.15 for 750 kwhr per month compared to $27.00 in 1953 and $37.09 in 1935. Industrial plants using 200,000 kwhr monthly paid $3281 in January compared to $2828 in 1940 and $3081 in 1935. Report makes no effort to fix the reasonableness of the bills.

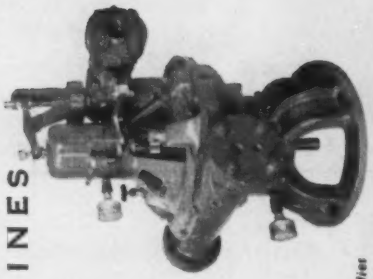
World's largest unit on line

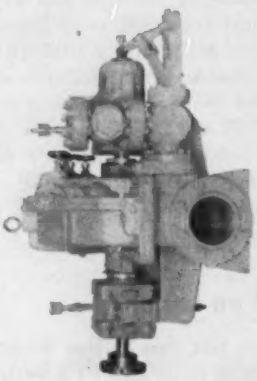
The 500-mw unit on test run at the Widows Creek Steam Plant will raise the TVA system capacity to 11,873,460 kw. Unit will burn 1,500,000 tons of coal a year at 0.75 lb per kwhr. A second 500-mw unit has been authorized for the plant, to start running in 1963. This will make Widows Creek the largest steam plant in the world—1,675,000-kw capacity. The largest now is TVA's Kingston Steam Plant with 1,440,000 kw in nine units.

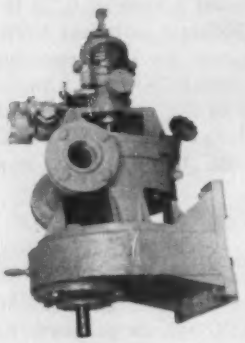
Revised hydro plans

The City of Los Angeles, Calif. has amended its application to the FPC for its proposed Bridge Canyon project on the Colorado River just above Lake Mead. The revised plan would install six 200-mw units instead of eight 125-mw ones. This reduces the powerhouse size, moves it closer to the dam. A chute type spillway would be built instead of two tunnel type spillways. The silt-retention dams would be built elsewhere than the Coconino site. Construction costs would drop from $243 to $204 million. This application conflicts with one filed by the Arizona Power Authority which proposes three developments, Bridge Canyon, Marble Canyon and the Little Colorado River, with an ultimate capacity of 1470 mw at a cost of about $347 million.

The NRC Equipment Corporation of Newton, Mass. has developed an electron furnace to melt high-temperature materials like tantalum, molybdenum, columbium, tungsten, thorium, cobalt, nickel and hafnium. The furnace makes ingots up to 4-in. dia and 14-in. long. A high-powered electron gun blasts a target melt area, while a magnetic focusing coil directs the beam.







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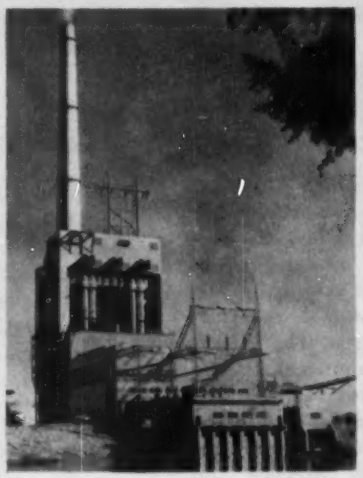
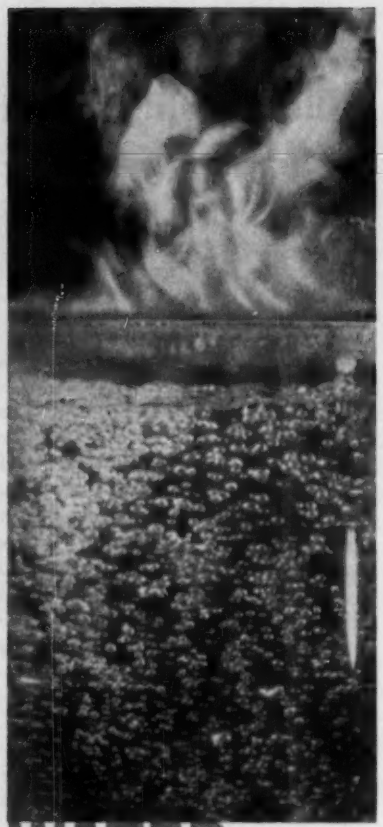


Giant power unit operates in Indiana

Capable of fulfilling the electric requirements of more than a million American homes, giant 475,000-kw turbine-generator is now in operation at Indiana & Michigan Electric Company's single-unit Breed Plant in Sullivan County, Ind. According to Philip Sporn, president of the company, unit's generating capacity was stepped up to the new rating of 475,000 kw from the original 450,000 kw after extensive tests. The electric-power generating unit, said to be the world's largest, was successfully operated at almost 500,000 kw. The unit is 40% larger than next biggest turbine-generator now in service.

Commercial operation climaxes a 3½-yr period of construction and testing on the unit. It's expected to be the most efficient power producer ever built, said Sporn. Factors contributing to this efficiency: steam pressure of 3500 psi, initial steam temperature of 1050 F and double-steam-reheat temperatures also of 1050 F. Unit may have a thermal efficiency of 40% in consuming 8535 Btu per kwhr generated.

Turbine-generator consists of equal size and capacity high-pressure, low-pressure sections. Each machine is 112-ft long, almost 21-ft wide and 15½ ft above floor level. Each section weighs 875 tons. Boiler for the plant is as high as a 23-story build-



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DEOXY-SOL removes oxygen, reduces oxides and raises pH of the condensate all at the same time . . . yet adds no solids.

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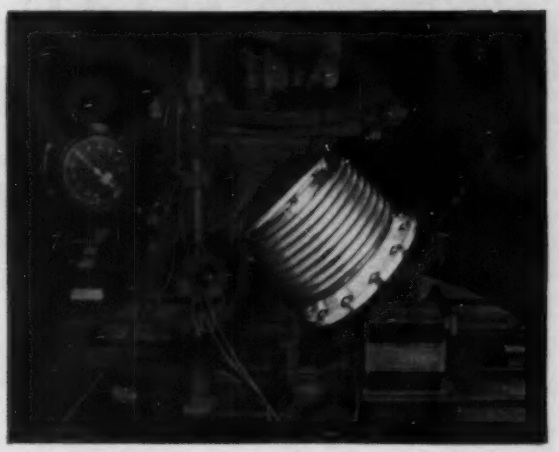
Fairmount CHEMICAL CO., INC.

circle 310 on Reader Service card, p 103

4 WAYS to get maximum reliability in expansion joints

1 Insist that the corrugated bellows be hydraulically formed. The reason is simple. Whenever bellows are formed by circumferential welding . . . whether by edge, seam or fillet welding . . . they will always be subject to premature failure because of stress concentrations at the welds.



2 Be sure the manufacturer maintains a continuous and comprehensive program of endurance testing. This is basic, because of the many variables that affect expansion joint life. Accurate determination of expansion joint life expectancy can only be determined by cycling to destruction.

3 Demand proof that the manufacturer can produce longitudinal welds in the corrugated bellows having the same strength, physical properties and thickness as the parent metal . . without grinding. A weld that is hard to find is a ground weld. Variations in weld thickness set up points of stress concentration . . . opening the way for premature failure.

4 Check the ability of the manufacturer to supply a team of *competent* design and application specialists to work with your engineers. Check their specific experience in handling critical, complex applications in your field . . . complete to the record of successes or failures behind them, and details of how this experience will be brought to bear on your problem.

At Zallea, none of the many factors affecting expansion joint reliability are left to guesswork . . . including the four vital ones above.

This is reflected in these facts. Zallea material specifications are the most exacting in the industry. Zallea expansion joints are hydraulically formed. Zallea advanced welding techniques insure welds having the same thickness, strength and physical properties as the parent metal. Zallea has done more cyclic testing to destruction than all government agencies and industrial firms combined. Zallea has produced more expansion joints than any other manufacturer . . . offers more application engineering experience.

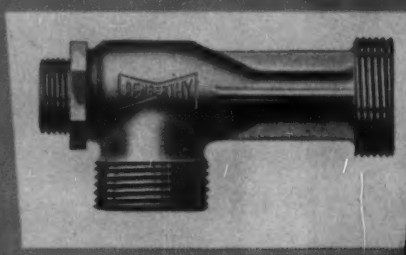
For all the facts, write for Catalog 56. Zallea Brothers, Taylor and Locust Streets, Wilmington 99, Delaware.

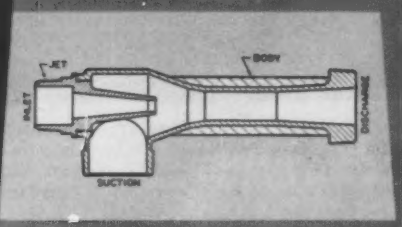
Zallea for maximum reliability

ZALLEA BROTHERS, Wilmington 99, Delaware • World's largest manufacturer of expansion joints

VERSATILITY

for applications unlimited





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For more facts circle 312 on Reader Service card, p 103

Powerscope

Begins on page 164

ing and produces 3-million-lb steam per hr. Turbine-generator was built by General Electric Co. Babcock & Wilcox Co built the boiler.

Water reactors win Soviet Lenin prize

Vienna, Austria (*McGraw-Hill World News*) Major achievement in Soviet science and engineering, water-moderated water-cooled research reactors, have won Lenin prizes for seven Soviet scientists and engineers working on peaceful uses of atomic energy. The new reactors, WR-2, WR-s and IRT, use ordinary water instead of graphite or heavy water as the moderator, have a simple heat-producing element and use a more economical fuel, TASS cables report.

The first Soviet WR-2 water reactor (on which there's been very little published) was cumbersome, expensive and had a complex design. It probably used natural uranium for fuel and graphite or heavy water as moderator. The ordinary water used in new design serves as moderator, neutron reflector and heat-carrying agent and helps shield against radiation.

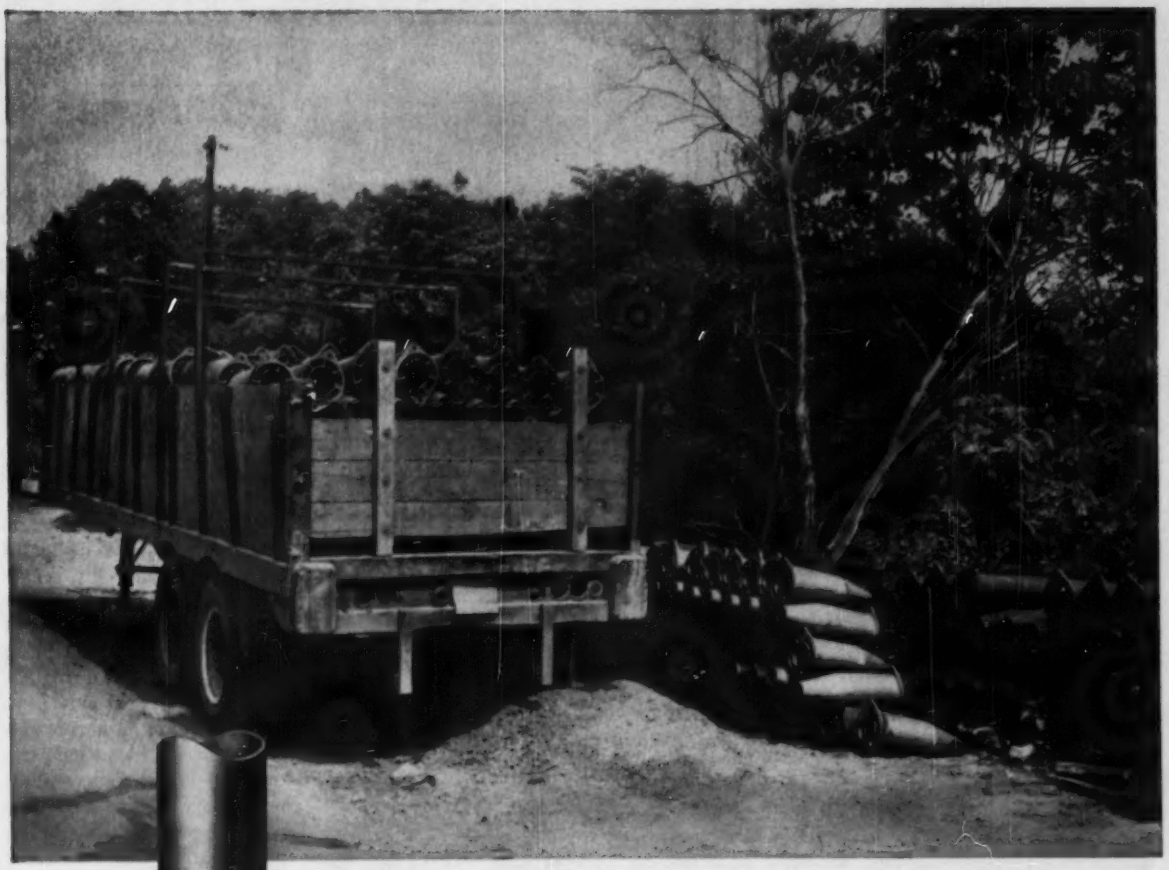
TASS claims the new Soviet reactors are superior because the central part (heat-producing element) is simple in design and technology. Fuel used has a relatively low degree of enrichment (up to 10% compared with 20-90% in American reactors).

Soviet Union is producing water reactors in series. Twelve reactors have already been built in the U.S.S.R., Romania, Czechoslovakia, the G.D.R., Poland and Hungary. Others are under construction in Bulgaria and the U.A.R. Water reactors are scheduled for China, the D.P.R.K. and Iraq.

Scientists pitch man against digital measurement

To study the intricate biological processes of man, scientists today use digital computers, rubber-tube systems and next, an artificial brain.

continued



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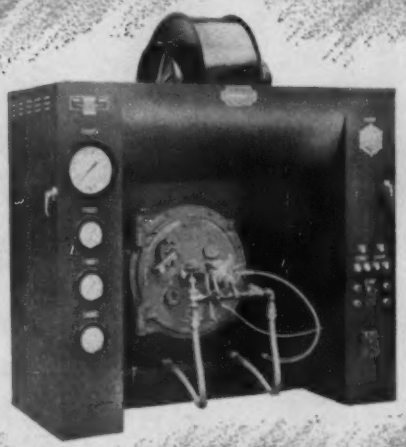

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"SAV-PAC" is built for trouble-free performance, extra economy using all grades of fuel oils, gaseous fuels or combinations of both. Self-contained unit includes register-type burner, forced draft fan, air-fuel controls, wiring and piping in separate enclosed panels, mounted complete.

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For more facts circle 314 on Reader Service card, p 103

Powerscope

Begins on page 164

Some engineers and physiologists meeting at the International Congress and Exhibition for Instrumentation and Automation at Dusseldorf and the ASME meeting at Dallas agree that medical science would be in a poor state without the contributions of mechanical processes, mathematics and computers. This process of simulated study bases itself on the biological parallels to control technology, data processing and simple physical and chemical systems.

One example of a control loop in the human body is the complicated mechanism required for ensuring constant blood temperature. This control sometimes calls for changes of the "set point"—infection will bring on a higher temperature as a countermeasure; sudden physical movement or emotions can cause an abrupt rise of the actual value of blood temperature because of higher cell combustion. Perspiratory glands are then stimulated to secrete and evaporating liquid draws excess heat from the body. Actual temperature value is returned to "set point."

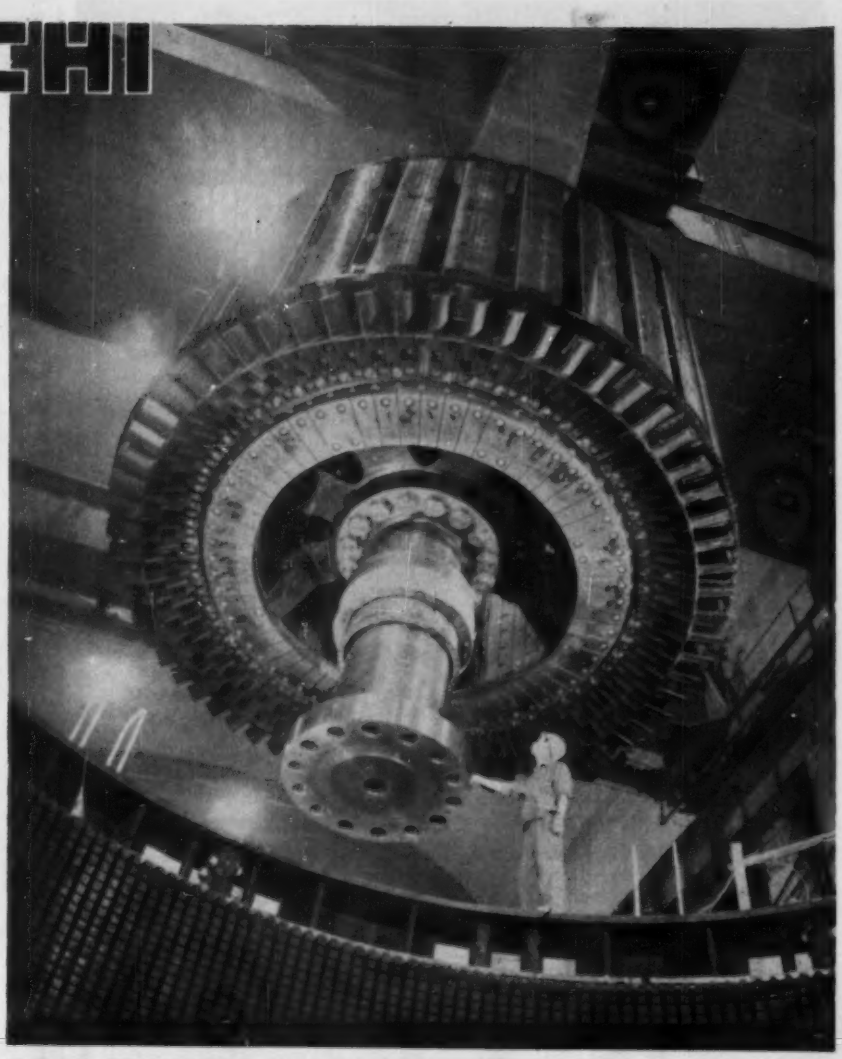
According to R W Stacy, associate professor of physiology and biophysics, and N A Coulter Jr, assistant professor of physiology and biophysics at Ohio State U, you can equate a human artery with a rubber tube filled with water. An electrical impulse can be matched to the behavior of a human pulse. Today a doctor can tell if a patient's arterial system is normal by feeding data on his patient's system into a computer and comparing this data with that of a normal system.

The computer may eventually become an extremely valuable tool for doctors making diagnoses, the scientists continued. Perhaps in 15 or 20 years a doctor will be able to collect data on a patient whose diagnosis is not obvious and transmit this data to a central medical computing agency. The computer will return an analysis stating the probable diagnosis and a recommendation for furthur data collection or for treatment.

The ultimate process of simulation would be design of an artificial brain. Everything perceived by the senses is first processed by logical functions

HITACHI

Another Big Hydraulic Turbine and Generator by Hitachi



Hitachi has recently completed two 137,500kw/125,000VA hydraulic turbine and generators for the Miboro Power Station in Central Japan. The turbine is of the vertical-shaft Francis type, and specified for a speed of 225rpm, a maximum effective head of 200m and 76.6 cu.m/sec. water flow, making it one of the largest units of its kind in the world. Its runner has a maximum diameter of 3.7m and the main shaft a diameter of 95cm. The spiral casing, which was constructed in 13 sections to facilitate transportation to the site, has an inlet diameter of 3.35m and an outer diameter of 11.2m.

The generator presents a high-torsoed appearance having been so designed in consideration of the comparatively high speed. Since the generator was designed for a rated voltage of 16,500 volts and, in this respect, represents the first such attempt in Japan, particular care was taken in the corona-shielding and impulse resistance of the stator winding. The generator is rated at 60 cycles, 225rpm and 0.9 power factor but is also capable of operating at 50 cycles, 187.5rpm and 1.0 power factor.

Hitachi, Ltd.
Tokyo Japan

Cable Address: "HITACHY" TOKYO

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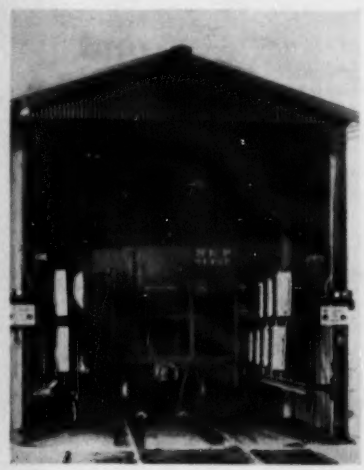
into simple binary elements before it can be stored in the brain. Impressions and thoughts are probably stored in the same way electrical digital computers operate by the binary system. Science already has artificial organs which can take over a function of the brain, the respiratory center. Next step on the simulation agenda: a transfer of human *personality* from a natural to an artificial brain.



Infrared heat station thaws U.S. Steel hopper cars

Thawing station at U.S. Steel Corp's Youngstown District Works is equipped with infrared-heated side panels, ceiling and floor. It works faster than torches thawing hopper cars and is safer, according to Hauck Mfg Co, builder of the new type of gas-operated equipment. Without adjustments it will thaw materials including coal, coke, anthracite, dolomite, limestone and sand.

Infrared rays travel through the air without becoming heat until they strike the object to be thawed and heating can be varied, so hopper cars at Youngstown are safe from over- or underheating. Floor units throw off 4-million Btu per hour, side panels some 2-million Btu while overhead units designed to remove a top crust of frozen materials do their job with only 300,000 Btu.

continued

For more facts circle 316 on Reader Service card, p 103
circle 317 on Reader Service card, p 103 ➤

Sludge in engine ends with switch to STANODIESEL Oil M

Situation: For five years a 1,400 hp. engine in the Municipal Light Plant, Arcadia, Wisconsin, was operated on STANODIESEL Oil M. During this time the engine ran free and clean. It carried a major share of the plant's 20,000 kw. output. A decision was made to switch the engine to another lubricant since it was believed one oil was as good as another.

What happened: Within two years the engine had sludged up so much, the oil had to be removed and replaced by STANODIESEL Oil M. Three months later the engine had cleaned up and was again carrying its share of the plant's load.

Clean engine operation is possible with STANODIESEL Oil M because of its superior base stock and its combination of additives that are available in no other oil. Superior base stock and exclusive additives give you these cost-saving operating and maintenance advantages: less sludging, low oil consumption, reduced port deposits, fewer stuck rings, less need for ring replacements, less cylinder wear, lower filtration costs, fewer bearing problems.

Get more facts about STANODIESEL Oil M. Call the Standard Oil office near you in any of the 15 Midwest or Rocky Mountain states. Or write **Standard Oil Company (Indiana), 910 South Michigan Avenue, Chicago 80, Illinois.**

You expect more from **STANDARD** *and you get it!*

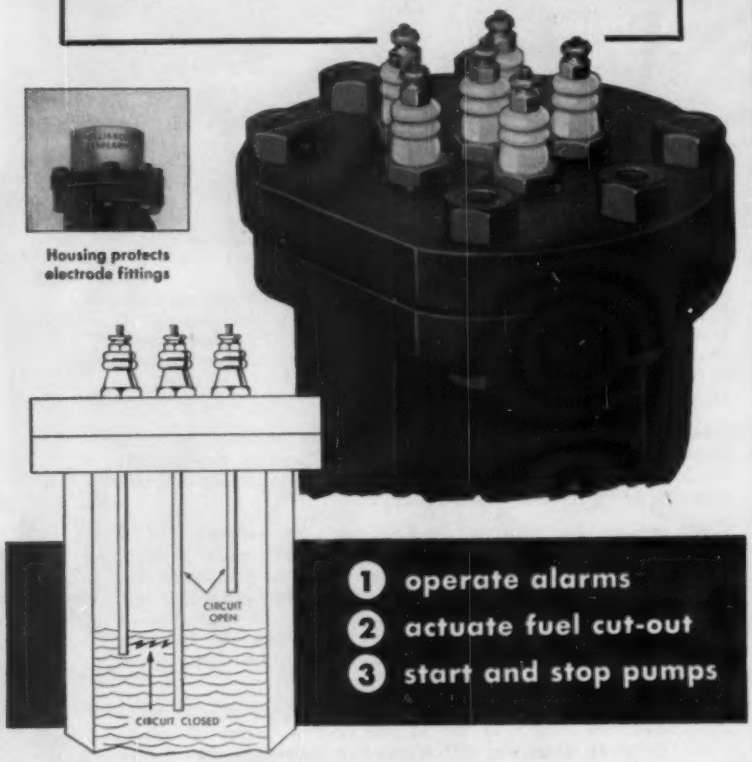
The team that got the engine back in shape; (l. to r.) Vernon Schwertel, Ronald Darbo and Standard's Fred Parkinson. Providing lubrication technical service on problems like this one is not new to Fred Parkinson. He's been doing it for 11 years. He has further qualification for such work—an engineering degree from Brown University. Fred has also completed the Standard Oil Sales Engineering School.

Quick facts about STANODIESEL Oil M

- Keeps crankcase, pistons, cylinder walls clean.
- Combats deposit and wear problems imposed by economy fuels.
- Maintains film on difficult-to-lubricate parts.
- Eliminates fuel injector and pump sticking caused by deposits on injector barrel and plunger where fuel and lube oil mix.

What could be simpler?

Your boiler water is a conductor;
Its rise and fall can be made to make and break circuits;
Simple efficient control to 1, 2, 3 (below)



1. operate alarms
2. actuate fuel cut-out
3. start and stop pumps

RELIANCE ELECTRODE LEVALARMS GIVE YOU *INSTANT ACTION* — at exact pre-set water levels. Minute transformer-isolated currents pass through boiler water in the column — actuate controls through relays. From one function (fuel cut-out or low water alarm) to combinations of up to *five or more* are possible with a Levalarm: low or/and high water level alarm, fuel cut-out, start and stop pumps, etc.

Electrode Levalarms are entirely electrical; they do not depend on vacuum tubes or magnets — have no stuffing boxes or bellows. Models available for every pressure or temperature.

It will pay you to get full information on Reliance Levalarms. Write the factory or contact nearest Reliance Representative.

The Reliance Gauge Column Co., 5902 Carnegie Ave., Cleveland 3, Ohio

Reliance BOILER SAFETY DEVICES

Powerscope

Begins on page 164

This method of thawing results in manpower and demurrage savings and helps eliminate damage to rolling stock, according to Hauck. One man can operate the package. All controls are located behind the equipment for safety.

Webster spelled it *sulphur* —until recently

Put the *ph* back into sulfur? Never, according to the Twentieth Century Webster. The old gentleman distinctly spelled it *sulfur* in his newest edition, conceding his original version to the soon-to-be-archaic listing. Local custom is finally winning out and the easier to spell and write *sulfur* gains precedence.

The history of this word tangle goes back many years. The *f* was used in the original form of this Latin word. In 1911, *Journal* of the American Chemical Society and *Chemical Abstracts* readopted the *f* spelling and have used it consistently. American chemists also usually use the simplified spelling. The American Medical Association *Journal* began to use *sulfur* in 1935 and the United States Pharmacopoeia followed suit.

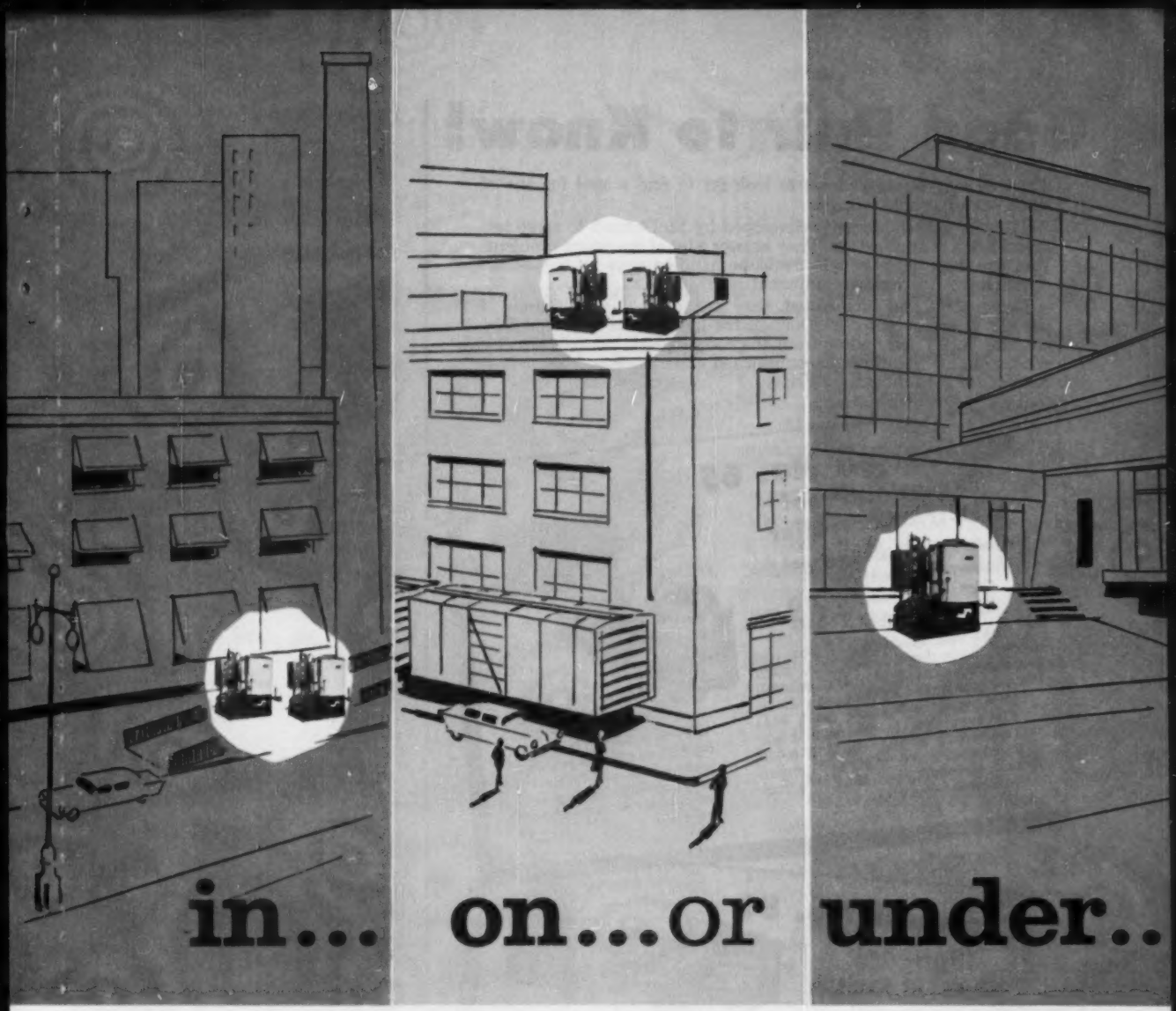
But not all technical groups abandoned *sulphur* for *sulfur*. The American Society of Mechanical Engineers, Technical Association for the Pulp and Paper Industry, Library of Congress and producers of 90% of the world's sulfur still use the *ph* spelling.

"Words About Words" published by American Chemical Society goes over the history of this spelling difference.

Giant Japanese linear accelerator in the making

Tokyo (*McGraw-Hill World News*) A Toshiba plant in Kawasaki just outside Tokyo is scene of the beginnings of the largest linear accelerator Japan has yet produced. A 25-mev unit with maximum output of 10 kv, it tops

For more facts circle 318 on Reader Service card, p 103
circle 319 on Reader Service card, p 103 ➤

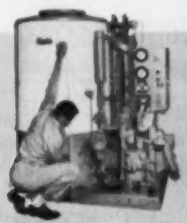


Leading beverage company proves "Steam The Modern Way" saves space

Illinois plant installed two 100 HP Claytons IN old smokestack ash pit, releasing many sq. ft. for plant expansion. Louisiana facility placed two lightweight Claytons ON the roof. California plant located Claytons easily UNDER loading dock.

This, indeed, is "Steam the Modern Way"... a 175 HP Clayton takes just 4 ft. x 7 ft. of floor space, stands just 8 ft. high. Write for full information on how Claytons can solve *your* space problems.

See Clayton Exhibit, National Power Show – N. Y. – Nov. 28-Dec. 2. Booth 171. 422



175 HP

Clayton Steam Generators

Clayton Manufacturing Company 465 No. Temple City Blvd., El Monte, Calif.

Good Pair to Know!

Chances are you won't have to look far to find a spot for one of these float-operated switches.

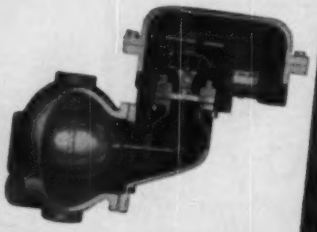
They have been specially developed by McDonnell to serve two broad fields of application. They answer a lot of operating problems that you may have thought could be handled only by make-shift or much more expensive equipment.

Dependable and time tested, they are just two of hundreds of products developed by McDonnell for liquid level or liquid flow control. When you choose from the complete McDonnell line it's good to know you draw on unmatched experience and know-how in this specialized field.

McDonnell No. 65
Explosion Proof Electric Controller

Underwriters' Listed for use in hazardous locations:
Class 1, Group C & D
Class 2, Group F & G

A float-operated switch for use under hazardous conditions, such as atmospheres containing butane, benzol, lacquer solvent, alcohols, acetone, coal and grain dust, etc. Can be furnished to make or break electric circuit at high- or low-level — to control motors, signal lamps, electric elements, etc. Suitable for internal pressures up to 40 psi.



Write for McDonnell Engineering Bulletin ERS-10 which discusses typical applications of No. 65, shows wiring diagrams for different patterns of operation.

McDonnell No. 80
High- or Low-Level Switch

Underwriters' Listed for use on oil tanks.

A float-operated three-terminal switch that can be used to provide high- or low-level alarm, or to start or stop a pump when level rises or falls. It makes possible reliable automatic control in place of gauge glass watching and manual control.

Write for McDonnell Engineering Bulletin ERS-9 which shows typical application of No. 80 on oil storage tanks, complete with wiring diagrams for draining or filling tanks, high- or low-level alarm, signal or cut-off.

Write for complete literature and engineering bulletins.

McDONNELL & MILLER, Inc., 3506 N. Spaulding Ave., Chicago 18, Ill.

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BOILER WATER FEEDERS • LOW WATER FUEL CUT-OFFS • PUMP CONTROLLERS • RELIEF VALVES • FLOW SWITCHES • RELATED LIQUID LEVEL CONTROLS FOR TANKS, STILLS, AIR CONDITIONING SYSTEMS

Powerscope

Begins on page 164

Toshiba giants built for Japan Atomic Energy Research Institute (20 mev) and the Government Industrial Engineering Laboratory (10 mev).

Expected completion: next April. This new accelerator is an improved version of the earlier models, will handle larger and thicker materials at a lower operating cost.

In building the unit, Toshiba plans to first manufacture a 13-mev pilot unit with maximum output of 4.7 kw, then install an accelerating tube and klystron to increase capacity to 25 mev and output to 10 kv.

Substation goes for a float

If you happen to be down by a San Francisco harbor, you might see a strange sight—an electric substation —afloat. Well, there's no better way to cool off on a hot afternoon, especially if you're a hot substation. Not so, according to L J Brundige, manager of Pacific Gas and Electric Co's San Jose Div. The 110,000-v substation floating in South San Francisco harbor has much to do and it's not cooling off. It's providing power for dredging a portion of Redwood City Harbor. This is the largest sub PG&E has ever mounted on a barge. It could serve the electric needs of a community the size of Menlo Park.

Sub was assembled at Utah Construction & Mining Co, operator of the dredge, and towed to the site where it will float during dredging operations. Utah's dredge, one of the world's largest, tips the scales at 2400 tons. It will connect to the sub by a 12,000-v armored submarine chain that reels out as the dredge moves along the channel. Power will come to the substation from one of PG&E's 110,000-v transmission lines serving along the Peninsula area.

Greased lightning goes through Edmonton

Edmonton, Alberta, Canada is pioneering use of aluminum electric cable in an oil-filled pipeline to distribute

Wolverine supplies condenser tube for Enrico Fermi Atomic Power Plant

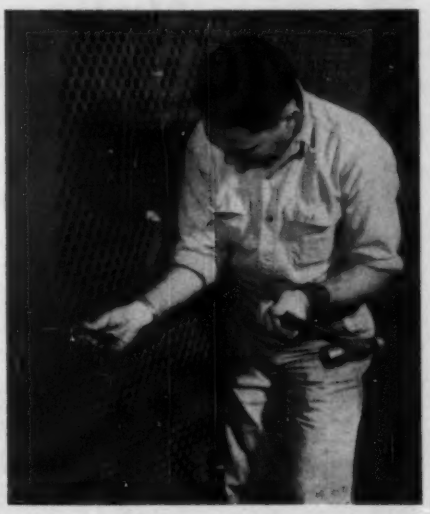
The increasing extent of the heat transfer services provided American industry by Wolverine Tube, Division of Calumet & Hecla, Inc., is demonstrated by the use of Wolverine prime surface condenser tube in the Enrico Fermi Atomic Power Plant near Monroe, Michigan. The plant is a combined project of The Detroit Edison Company and the Power Reactor Development Company.

For this critically important installation, Wolverine Tube has supplied more than 500,000 feet of prime surface admiralty condenser tube for the main steam condenser.

This tubing, as is all Wolverine condenser tube, was "coupon tested" during manufacturing. In this program, samples are clipped from the end of each length of condenser tube. Mechanical expansion tests of each sample assures that the tube will withstand flaring or rolling-in operations without cracking or splitting.

Wolverine Tube is extremely proud that the high quality of its condenser tube products is helping bring the wonders of atomic power closer to daily reality.

If your company is engaged in heat transfer, it is highly probable that Wolverine Tube can help you do a better job more economically. Our consultation services are available to you without obligation. Let us provide additional information on our services and facilities—write today.



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DIVISION OF
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Manufacturers of Quality-Controlled Tubing

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PLANTS IN DETROIT, MICHIGAN AND DECATUR, ALABAMA • SALES OFFICES IN PRINCIPAL CITIES

For more facts circle 321 on Reader Service card, p 103

ROBVON BACKING RINGS

FAST • PRECISE TOLERANCE FIT-UPS

Designed for quick easy alignment of pipe where the variation in inside diameters is relatively great. Chamfered NUBS allow close tolerance fit-up and CLEAN STRIKE OFF. The ROBVON NUB automatically sets root gap. ROBVON rings are beveled to assure non-restricted fluid flow. Available in Carbon Steel, Wrought Iron, Chrome Alloys, Stainless Steel and Aluminum.

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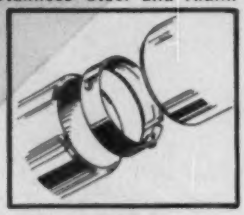

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For more facts circle 322 on Reader Service card, p 103

BOILER TUBE COMPANY OF AMERICA

McKEES ROCKS, PA. (Pittsburgh District) Federal 1-7750

For more facts circle 323 on Reader Service card, p 103

Powerscope

Begins on page 164

city power. Aluminum cable is carried in a 5-9/16-in.-dia pipeline filled with a specially refined oil at 200 psi. Pipeline stretches for five miles under boulevards and roadbeds.

The city laid first oil-electric line in 1957 using copper conductors. A year later they followed it with a similar pipeline. This is the first line using aluminum — at a saving of $17,000—according to C Z Monaghan, superintendent of the system.

Oil in the pipeline acts as both an insulating and a cooling medium: it insulates cable wrappings, and as a coolant it transmits heat to the pipe for dispersal through the earth. The 5-mile line is expected to cost $443,210 and will handle power up to 72,000 v. For a maximum four hours at a time, line can handle as much as 80,000 khv, an amount equivalent to the total city requirements in 1954.

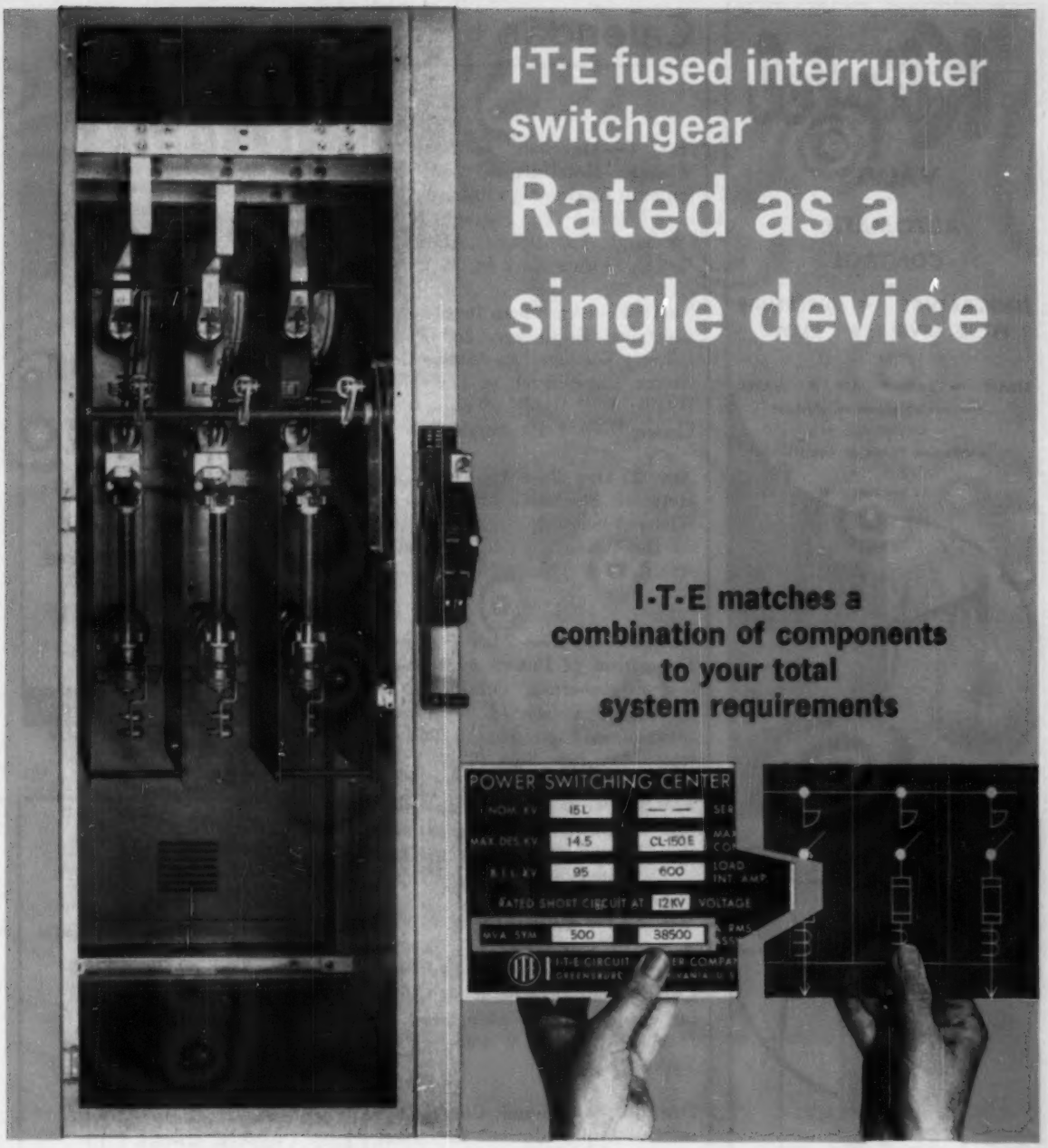
Power poles rain over Knoxville, Tenn.

Power poles, 4000 lb at a throw, are raining over Tennessee Valley Authority territory with the help of a Sikorsky-58 helicopter and its skilled pilot. The trick is a real thriller for observers as they watch giant pencils fall from the sky. And it's a very productive one for TVA, according to W B Richardson, chief of the TVA experiment. The 'copter trick and a small ground crew set from 75 to 85 poles a day (15 an hour).

The trick isn't as easy as it seems, though. Observers can see more of the pole-setting process than the helicopter pilot who has to rely on communications system. And some of the poles, 50- to 75-ft long, are too heavy for the 'copter to lift.

Here's how they do it. Poles are fitted with crossarms and insulators at a staging yard before they go aloft. After a 2½-mile flight carrying more weight than the average car, the 'copter hovers and lowers pole to two men ready to guide it in. Ground crew consists of 12 men who leapfrog from site to site to await the helicopter and its cargo of poles.

New pole-setting process uses only 1/3 as many men and eliminates trucks, winches and other gear.



Now you can slash power switching costs and forget a confusing array of ratings. With I-T-E's advanced Power Switching Centers you only concern yourself with specifying your system conditions of operating voltage, available short circuit and load requirements. I-T-E then matches a *single assembly* of switch, operating mechanism, fuse and housing. You are assured of an integrated unit that will safely withstand the effects of *closing*, *carrying* and *interrupting* all values of current up to your system's specific short circuit capability (up to 600 amperes, continuous—500 mva short circuit). Realize maximum economy where *all* the features of circuit breakers are not required. Prevent misapplication of protective equipment with I-T-E's Single Assembly Ratings. Call your nearest I-T-E sales office or write I-T-E at Greensburg, Pennsylvania.

I-T-E CIRCUIT BREAKER COMPANY

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AUTOMATIC CONTROL

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FLUID LEVEL • FLOW

of

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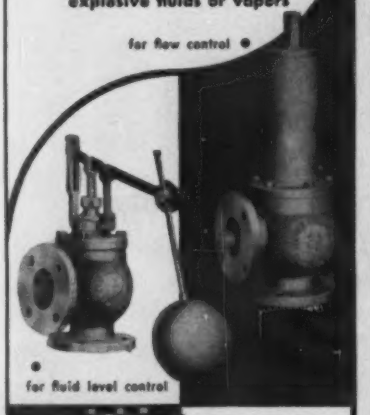
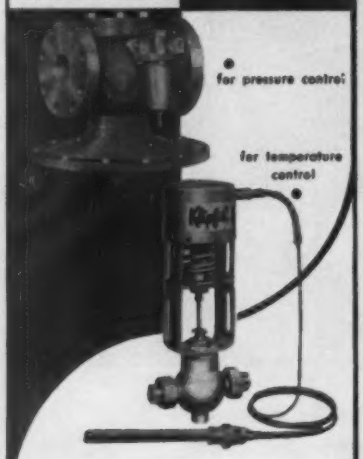
viscous or abrasive sludges
CHEMICALS
explosive fluids or vapors





Special designs for application to original equipment. ENGINEERING

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HAMILTON, OHIO
A DIVISION OF THE HAMILTON-THOMAS CORPORATION

circle 325 on Reader Service card, p 103

Calendar

Nov 4—American Institute of Mining, Metallurgical and Petroleum Engineers, Pittsburgh Section, Meeting, Penn Sheraton Hotel, Pittsburgh, Pa. Details: AIME, 29 W 39th St, New York 18, N. Y.

Nov 9-11—American Institute of Electrical Engineers, 2nd Power Industry Computer Application Conference, Chase Hotel, St. Louis, Mo. Details: E L Hardes, Westinghouse Electric Corp, E Pittsburgh, Pa.

Nov 27-Dec 2 — American Society of Mechanical Engineers, Winter Annual Meeting, Statler Hilton Hotel, New York, N. Y. Details: ASME, 29 W 39th St, New York 18, N. Y.

Nov 28-Dec 2 — 24th National Exposition of Power & Mechanical Engineering, Coliseum, New York City. Details: E K Stevens, International Exposition Co, 480 Lexington Ave, New York 17, N. Y.

Nov 30-Dec 2 — American Institute of Mining, Metallurgical and Petroleum Engineers, Electric Furnace Conference, Morrison Hotel, Chicago, Ill. Details: AIME, 29 W 39th St, New York 18, N. Y.

Dec 4-7—American Institute of Chemical Engineers, Winter Meeting, Statler Hotel, Washington, D.C. Details: AIChE, 25 W 45th St, New York 36, N. Y.

Dec 5-8 — National Conference on the Application of Electrical Insulation, Conrad Hilton Hotel, Chicago, Ill. Details: F C Osterland, Allis-Chalmers Mfg Co, Milwaukee, Wis.

Dec 12-15—Atomic Industry Exhibition, California Masonic Memorial Temple, San Francisco, Calif. Details: Atomic Industrial Forum, 3 E 54th St, New York 22, N. Y.

Dec 12-15 — Industrial Building Exposition & Congress, Coliseum, New York City. Details: Banner & Greif, 369 Lexington Ave, New York 17, N. Y.

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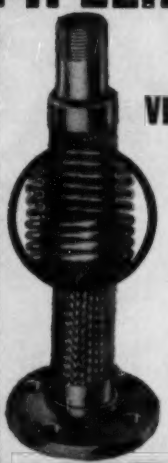
CALM Jittery PIPELINES



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YOUR POSTMASTER SUGGESTS:

Avoid the Last Minute Christmas Holiday Rush!

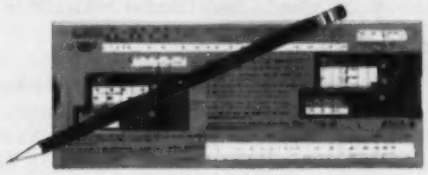
MAIL EARLY!!

"For Distant Out-of Town Points, Mail by December 10, 1960"

"For Delivery in Your Local Area, Mail by December 16, 1960"

Now get fast answers to your water hardness problems

Handy new Morton Calculator gives you data at your fingertips when planning or improving hard water treatment systems.



With this amazing new calculator you can accurately determine for yourself the requirements of a water softening installation. You can quickly figure: the conversion of p.p.m. water hardness to grains per gallon hardness; the amount of exchange resin; the brine and salt requirements for maximum efficiency; and brine tank size and operating brine level adjustments.

You can make daily use of the calculator in selecting tank sizes for liquid volume problems. This Morton Ion Exchange Calculator comes to you free of charge.

Morton's Brine Engineers will be happy to work with you on brinemaking problems. Their experience and service can save you time, money and labor in the planning or improvement of brinemaking systems. Morton technical assistance will assure maximum operating efficiency and the latest labor-saving techniques in brinemaking.

Mail coupon today for your free Morton Ion Exchange Calculator, and, if you wish, you also may ask for information about Morton's Brine Engineering Services.

○ I would like a free Morton Ion Exchange Calculator.

○ I would like to learn more of Morton Brine Engineering Services.

Name _____ (Please Print)

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INDUSTRIAL DIVISION

Dept. P-11, 110 N. Wacker Drive, Chicago 6, Illinois

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- Capacity approximately 1½ times greater than globe valves.
- Handles temperatures from −60°F. to +450°F.
- For 60° throttling or 90° on and off.
- Equal percentage flow for good control.
- Closing speeds as fast as ⅓ second.
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Available in special materials or construction and as manual or with various types of operators.

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For more facts circle 328 on Reader Service card, p 103

Smoothest stack I know!

A. O. Smith glass-protected smokestacks are virtually impervious to corrosion

Smoothest stack on the market because A. O. Smith glass-protected stacks are corrosion-resistant regardless of excess condensate. This glass protection gives you three to five times longer life than with unlined steel stacks. Also pays off in lower installation and maintenance costs — lightweight A. O. Smith stacks can't rust, never require painting. Now available in *eight* attractive colors. For colorful new bulletin, write Dept. 110.

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SMOKESTACK SALES
ATOMIC & PROCESS
EQUIPMENT DIVISION
P.O. Box 584
Milwaukee 1, Wisconsin

For more facts circle 329 on Reader Service card, p 103

Calendar

Begins on page 180

Jan 16-19, 1961 — Instrument Society of America, Winter Instrument-Automation Conference and Exhibit, Sheraton-Jefferson Hotel, Kiel Auditorium, St. Louis, Mo. Details: Meetings Services Dept, ISA, 313 Sixth Ave, Pittsburgh 22, Pa.

Jan 17-18—American Society of Lubrication Engineers, Bearing Symposium, Penn-Sheraton Hotel, Pittsburgh, Pa. Details: C L Willey, 84 E Randolph St, Chicago 1, Ill.

Jan 18—Metallurgical Society of AIME, Conference on Bar and Allied Products, Penn-Sheraton Hotel, Pittsburgh, Pa. Details: Metallurgical Society of AIME, 29 W 39th St, New York 18, N. Y.

Feb 13-16—American Society of Heating, Refrigerating and Air-Conditioning Engineers, 15th International Heating & Air-Conditioning Exposition, International Amphitheatre, Chicago, Ill. Details: E K Stevens, International Exposition Co, 480 Lexington Ave, New York 17, N. Y.

Feb 19-23 — American Institute of Mining, Metallurgical and Petroleum Engineers, Annual Meeting, Chase & Park Plaza Hotels, St. Louis, Mo. Details: AIME 29 W 39th St, New York 18, N. Y.

Feb 26-March 1—American Institute of Chemical Engineers, Meeting, Roosevelt Hotel, New Orleans, La. Details: AIChE, 25 W 45th St, New York 36, N. Y.

Feb 26-March 2—Annual Meeting, Metallurgical Society, Society of Mining Engineers, Society of Petroleum Engineers—AIME, Ambassador and Chase-Park Plaza Hotels, St. Louis, Mo. Details: AIME, 29 W 39th St, New York 18, N. Y.

March 5-9—American Society of Mechanical Engineers, Gas Turbine Power Div, 6th Annual Gas Turbine Conference and Products Show, Shoreham Hotel, Washington, D.C. Details: C V Corbin, 20 Vesey St, New York 7, N. Y.

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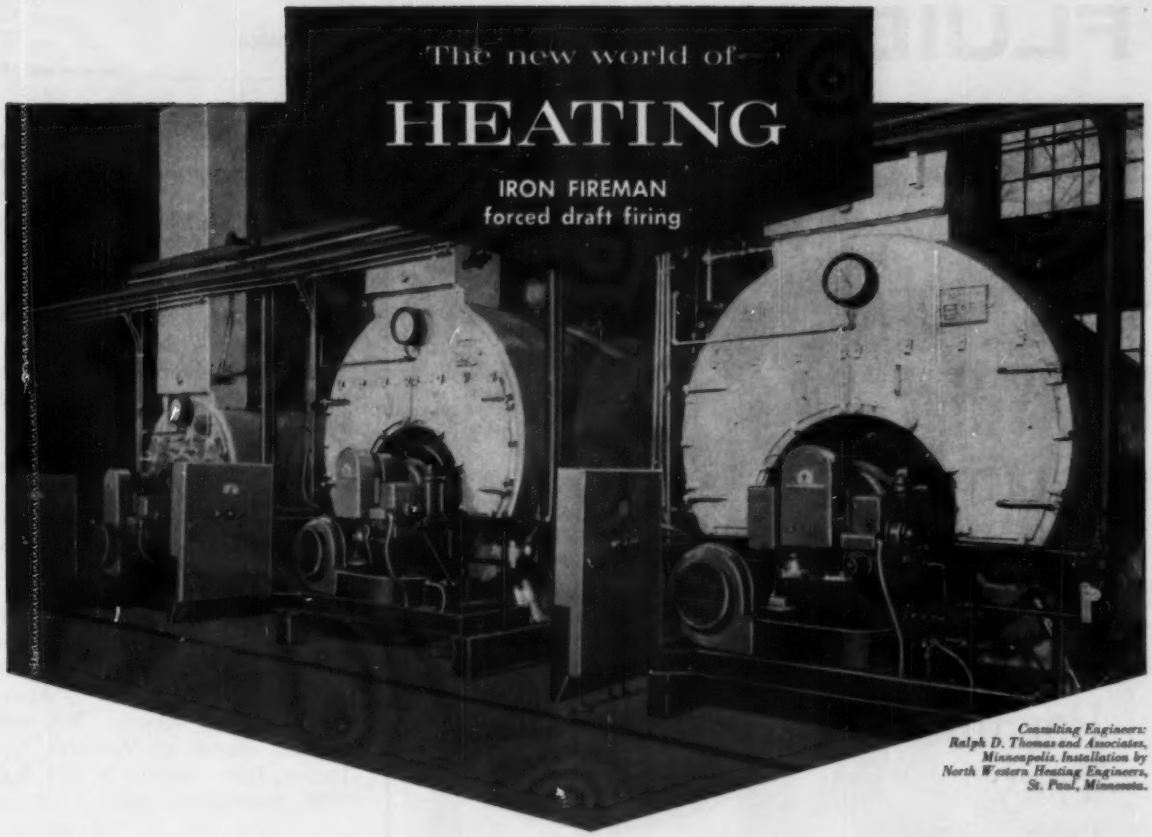


Consulting Engineers: Ralph D. Thomas and Associates, Minneapolis. Installation by North Western Heating Engineers, St. Paul, Minnesota.

This new heating plant increased boiler capacity 70%, yet will return the investment in 7 years

The Minnesota Masonic Home in Minneapolis faced a problem that is familiar to many owners of old heating plants—should the old plant be modernized or replaced?

After a thorough study of several alternatives, the engineering firm of Ralph D. Thomas and Associates recommended a complete replacement. The three Iron Fireman-Kewanee boiler-burner units shown above provide extra capacity for future needs, while cutting steam costs so sharply that engineers estimated they will pay for themselves in seven years.

COMPLETE, PACKAGED FIRING SYSTEM

The first big saving was in installation—the three units were moved in intact. No boiler settings, no brickwork, no special wiring required. The factory assembled units included boilers, burners, forced draft air supply, wired and tested control panels and fuel systems, all mounted on a permanent base. Low operating costs were the result of high combustion efficiencies (reduced fuel bills) and low maintenance. With packaged installation, factory responsibility covers practically the entire job.

FOR OIL, GAS OR DUAL-FUEL FIRING

Oil models fire any grade of oil from No. 2 to No. 6. Gas models take any type of high or low pressure gas. With dual-fuel models, fuels can be switched at a moment's notice with either manual or automatic controls.

Mail coupon for full information.

IRON FIREMAN

HEATING AND AIR CONDITIONING
AIRCRAFT COMPONENTS AND EQUIPMENT
MISSILE AND AIRCRAFT GYROSCOPES
ELECTRONIC EQUIPMENT
CONTROL INSTRUMENTS

Iron Fireman Mfg. Co., 3058 W. 106th St., Cleveland 11, Ohio
(In Canada, 80 Ward St., Toronto)

Please send complete technical description and specifications on Iron Fireman forced draft firing.

Name_____

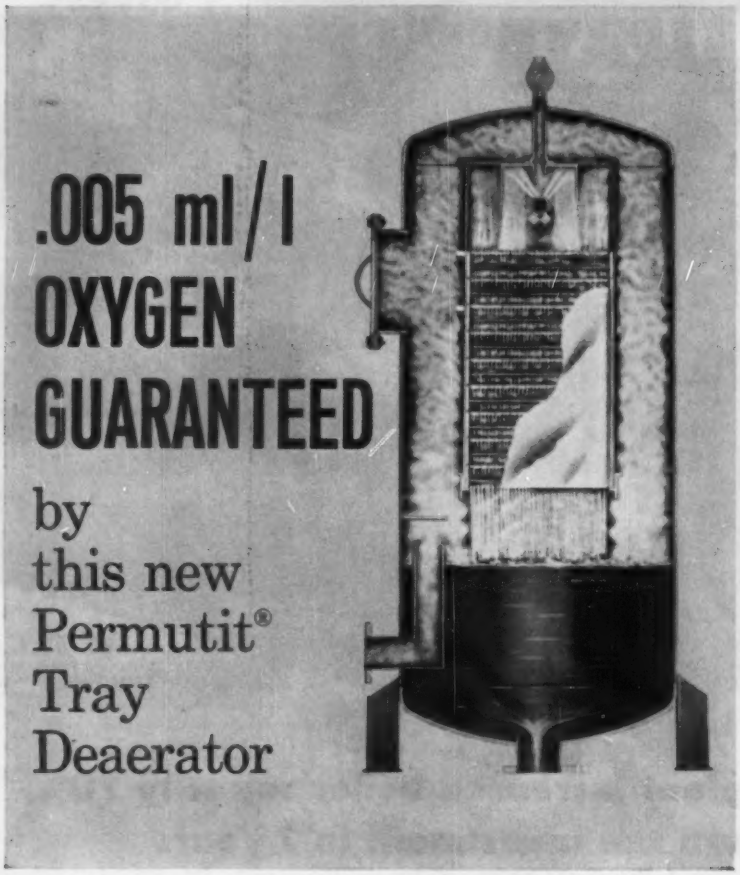
Firm_____

Address_____

City_____ State or Prov._____

For more facts circle 330 on Reader Service card, p 103

FLUIDICS* AT WORK



The picture above illustrates the new Permutit Tray Deaerator, which is *guaranteed* to reduce oxygen to .005 ml/l, or less, and to remove all the free CO_2.

This sectioned illustration shows the stainless steel trays and inner chamber. Steam passes upward through them, while the water spills down from tier to tier, constantly being exposed to the steam until, fully deaerated, it reaches the reservoir at the bottom.

The highest temperature incoming steam contacts this final deaerated water. It is also the purest, oxygen-free steam, and as it sweeps upward it takes to the vent all the freed corrosive gases.

The highly efficient internal vent condenser saves B.T.U.'s by reducing vented steam to a negligible wisp which is just enough to carry off all the non-condensable gases.

Guaranteed Water

These and the other design aspects of the Permutit Tray Deaerator enable us to give you a *guarantee* that you'll always get feedwater with (a) less than .005 ml of oxygen per liter of water, and (b) no titratable free CO_2.

And just off the presses is our Bulletin 4732, containing information on the construction details, operation, and other advantages of the Permutit Tray Deaerator. Send for a copy.

Permutit Division, Dept. PO-110, 50 West 44th Street, New York 36, N. Y. In Canada, The Permutit Company of Canada, Ltd., 207 Queen's Quay West, Toronto 1, Ontario.

*FLUIDICS is the Pfaudler Permutit program that integrates knowledge, equipment and experience in solving problems involving fluids.

PFAUDLER PERMUTIT INC.

Specialists in FLUIDICS . . . the science of fluid processes

For more facts circle 331 on Reader Service card, p 103

Calendar

Begins on page 180

March 13-17—National Association of Corrosion Engineers, 17th Annual Conference and Show, Hotel Statler, Buffalo, N. Y. Details: T J Hull, 1061 M&M Building, Houston 2, Texas.

March 20-24—American Society for Metals, Western Metal Show, Pan-Pacific Auditorium, Los Angeles, Calif. Details: J C Nelson, Metals Park, Novelty, Ohio.

March 21-30—American Chemical Society, National Meeting, St. Louis, Mo. Details: R Avery, American Chemical Society, 2 Park Ave, New York 16, N. Y.

March 27-31 — National Symposium on Temperature—its Measurement and Control in Science and Industry, sponsored by Amer-an Institute of Physics, ISA, and National Bureau of Standards, Columbus, Ohio. Details: W R Tilley, NBS, Washington, D.C.

April 10-12—American Institute of Mining, Metallurgical and Petroleum Engineers, Open Hearth & Blast Furnace Conference, Sheraton Hotel, Philadelphia, Pa. Details: AIME, 29 W 39th St, New York 18, N. Y.

April 17-19—Instrument Society of America, 7th National Symposium on Instrumental Methods of Analysis, Veterans Memorial Auditorium, Columbus, Ohio. Details: ISA, 313 Sixth Ave, Pittsburgh 22, Pa.

April 26-27 — Metallurgical Society of AIME, National Technical Conference On H-T Materials, Pick-Carter Hotel, Cleveland, Ohio. Details: Metallurgical Society of AIME, 29 W 39th St, New York 18, N. Y.

April 30-May 3 — Electrochemical Society, Meeting, Claypool Hotel, Indianapolis, Ind. Details: Electrochemical Society, 1860 Broadway, New York 23, N. Y.

May 1-3 — Electric Association, Lighting Exposition, Lake Front Exposition Hall, Chicago, Ill. Details: Electric Association, 140 S Dearborn St, Chicago 3, Ill.

accuracy

ASHCROFT DURAGAUGES measure pressure with precise accuracy no matter how severe the conditions of service

Ashcroft Duragauges are available in pressure ranges from 15 psi (or vacuum) minimum to 100,000 psi. Dial sizes: 4½" through 12".

sustained

The Bourdon tube in Ashcroft Duragauges is manufactured to precision standards of flexibility and mono-linked to the rotary movement. When pressure flexes the tube, the gauge pointer is always positively positioned, because it is mounted on the geared center shaft of the movement. Sustained high accuracy and long life are assured.

Choose your Ashcroft Duragauges made of components best suited to your needs. Eight Bourdon tube materials are available. Movement of stainless steel with nylon bearings and pinion gear for longest wear. Case materials: special aluminum alloy or tough phenol plastic.

The unique "Maxisafe®" Duragauge provides absolute protection to the viewer, plus easy and quick access to the mechanism. Your industrial supply distributor will help you select the best combination of components for your Ashcroft Gauge requirements. Phone him today or write for Catalog 300B.

ASHCROFT PRESSURE GAUGES

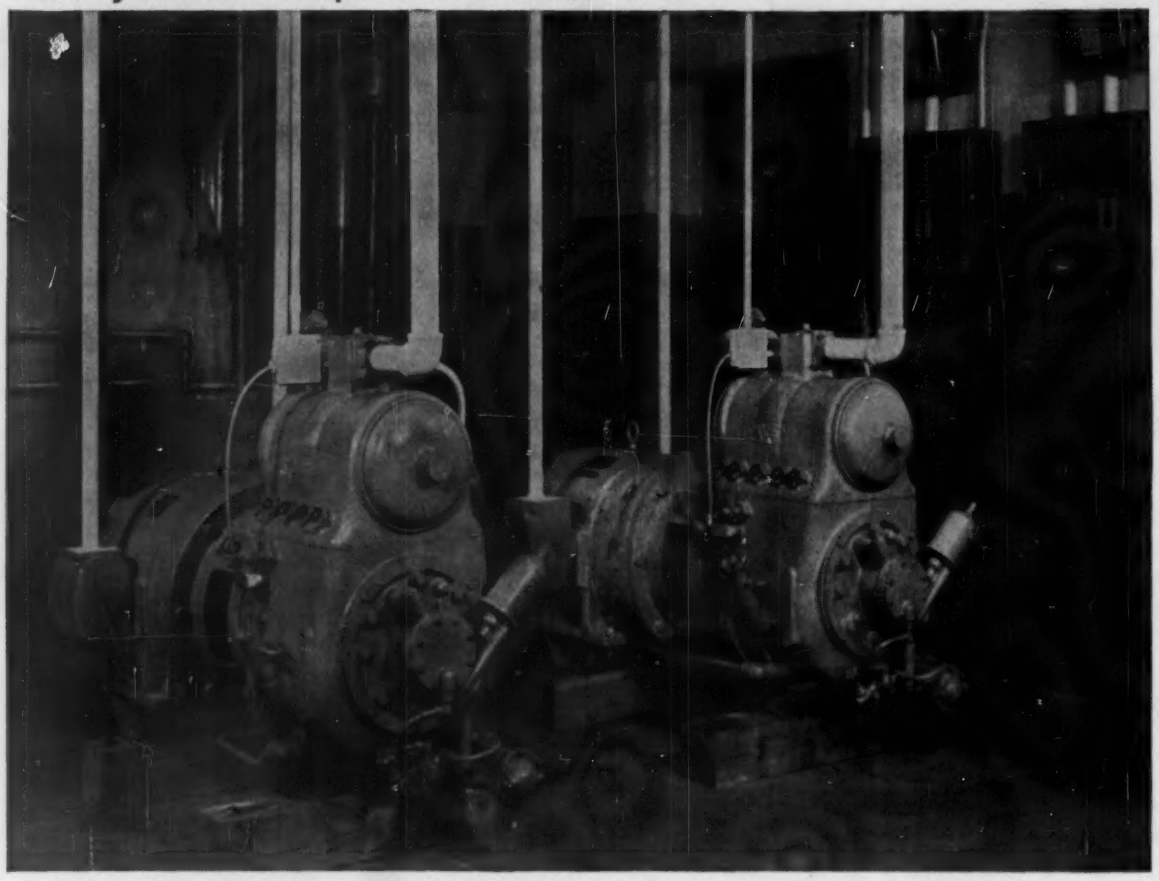
A product of

MANNING, MAXWELL & MOORE, INC.

Gauge and Instrument Division • Stratford, Connecticut
In Canada: Manning, Maxwell & Moore of Canada, Ltd., Galt, Ontario

For more facts circle 332 on Reader Service card, p 103

today's best compressor investment



These 2 Davey 40 h.p. Hydrovanes each deliver 166 c.f.m. of free air for a plastics manufacturer. Unit No. 1, installed in mid-1957, has operated 24 hours a day, 5½ days a week, without shutdown. Machine No. 2 is now in its 6th month of trouble-free service. Note: both compressors are attached to wood blocks, illustrating simplicity of mounting.

DAVEY HYDROVANE ROTARY

Inexpensive to install • Economical to operate
Easy to move • Simple to maintain
**Perma-Vane Blades*

Only one compressor—the Davey Hydrovane Rotary—meets needs of modern production.

Only Davey offers patented, long-life Perma-Vane blades. These eliminate deterioration and breakage—the biggest source of rotary compressor trouble. Davey has 50% fewer working parts than most other units.

Only Davey is quiet, vibrationless, lightweight, compact . . . most inexpensive to install in the least space. Davey Hydrovanes are completely enclosed. No exposed belts or couplings! They can be located anywhere, do not require compressor rooms or special foundations.

Only Davey produces 180° discharge air—lower than reciprocating compressors. Only Davey gives you the option of air-cooled, or water-cooled units.

Only Davey offers a complete line of 2 to 125 h.p. rotary stationary compressors for 100 p.s.i. operation.

For facts about today's *only really modern* compressors, see your local Davey distributor. Or write for Bulletin E. A-1270A

*U.S. Patent No. 2,905,376

Distributors in all principal cities

DAVEY pioneers of air-cooled air

Industrial Division

DAVEY COMPRESSOR CO.

Kent, Ohio

For more facts circle 333 on Reader Service card, p 103

Cost Cutting Combo

for Thermocouple Extension Wire Installations

Here's an economy team to increase efficiency and cut costs up to 75% in your next thermocouple extension wire installation. Multi-conductor "Thermo-cable" permits you to install from 6 to 56 pairs of color-coded, insulated thermocouple leads, at one time, using just one cable. Terminate the wires in a weatherproof multi-terminal box specifically designed for "Thermo-cable".

No more pulling individual leads through conduit. And, "Thermo-cable", with its polyvinyl chloride weatherproof, heat and corrosion resisting outer sheath often eliminates the need for conduit. Direct burial types available to eliminate hazards from fire and mechanical damage.

T.E. weatherproof Terminal Boxes are made of cast iron or sheet steel, can accommodate from 6 to 100 circuits, and offer sure protection against the effects of contaminating atmospheres. Made to N.E.M.A. or JIC specifications.

Write today for Catalog 83-42.

Thermo Electric CO., INC.
SADDLE BROOK, NEW JERSEY

In Canada: THERMO ELECTRIC (Canada) LTD., Brampton, Ont.

circle 334 on Reader Service card, p 103

Appointments

Management changes

Allis-Chalmers Mfg Co: D F Eyster, project manager, nuclear products. **American-Standard, Detroit Controls Div:** T G Breitag, manager of manufacturing engineering. G B Supple, director of product development and air-conditioning systems of Industrial Div. **Associated Research, Inc:** R W Inman, president.

Baldwin-Ehret-Hill, Inc: E R Stevens, president; A M Ehret Jr, chairman of board. **Borg-Warner Ltd:** J R Mueller, general manager of chain and sprocket operations. **Burgess-Manning Co:** T P Walker, director. **Burns and Roe, Inc:** M A Forrest, vice-president. **Colvin Laboratories, Inc:** J A Felty, plant manager.

Dynatom: J A Leurin, president; R Julia, vice-president and assistant to the president. **Daystrom, Inc, Weston Instruments Div:** J F Degen, vice-president and general manager; E L Klein, vice-president of operations. **Eastern Gas and Fuel Associates:** R P Tibolt, president and chief executive officer. **Garlock Inc:** J E Brennan, assistant to the president; J A Henderson, supervisor of Research and Development Section, Engineering Dept.

General Electric Company: W J McLachlan, manager of Electric Utility Systems Engineering Operation; M L Beck, manager of manufacturing of High-Voltage Switchgear Dept; V D Nixon, manager of Atomic Power Equipment Dept. **General Mills, Inc, Mechanical Div:** J H McGarry, director of manufacturing.

H K Porter Company, Inc, Forge & Fittings Div: W D Fullerton, general manager. **ITEC Corp:** G R Owens, president. **Kaiser Industries Corp:** G Havas, vice-president and director of engineering. **Marcus Transformer Company:** D A Thorn, L J Siegal—directors. **McGraw-Edison Company:** A Bersted, president; M McGraw, chairman of board, R H Giesecke, executive vice-president and treasurer.

Midwest Piping Company, Inc: H W Baird, director. **National Bureau of Standards:** Dr M G Broad-

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REGULATORS & CONTROLS

If your company and your job depend on power generation, you should know all there is to know about information systems, stepchart recorders, analog computer controls and similar components of an efficient power system.

You know the part they play in high efficiency power generation and you can build and supplement this knowledge at the Power Show. Exhibitors include manufacturers of products like automatic pH controllers, control valves, flow controllers, pressure, vacuum and absolute pressure controllers—PLUS a broad line of other power and allied equipment.

Only at the Power Show do you have the opportunity to investigate, compare and get the right answers, face-to-face, from the manufacturers themselves. Only at the Power Show can you see over 250 leading suppliers' products, all conveniently grouped together at one time.

Make sure you're there. Every one else will be!

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NEW YORK COLISEUM

NOV. 28—DEC. 2, 1960

MANAGEMENT: INTERNATIONAL EXPOSITION COMPANY
480 Lexington Ave., New York 17, N. Y.

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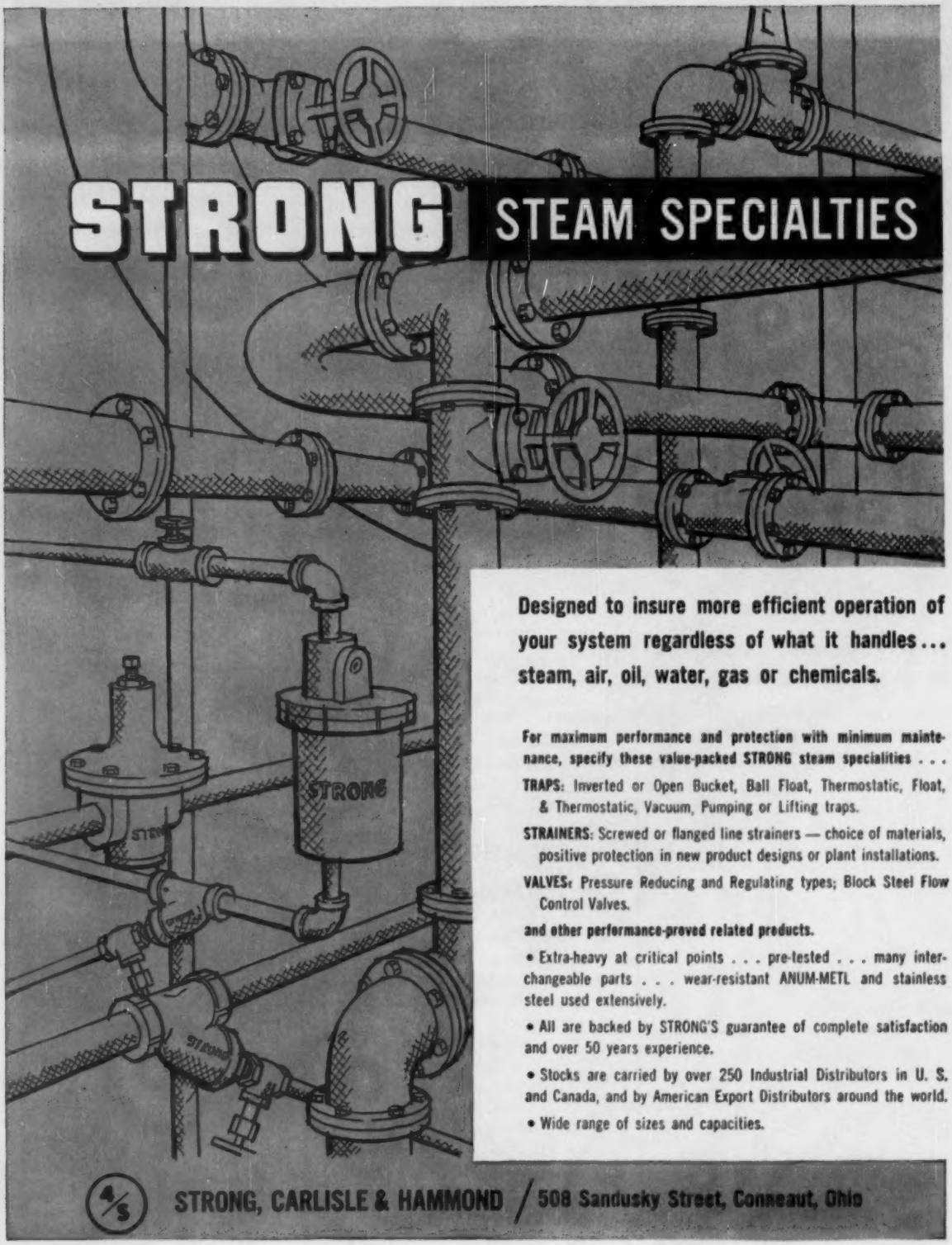

Designed to insure more efficient operation of your system regardless of what it handles... steam, air, oil, water, gas or chemicals.

For maximum performance and protection with minimum maintenance, specify these value-packed STRONG steam specialities . . .

TRAPS: Inverted or Open Bucket, Ball Float, Thermostatic, Float, & Thermostatic, Vacuum, Pumping or Lifting traps.

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and other performance-proved related products.

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FOR FAST AND RELIABLE SERVICE... Buy from your local Industrial Distributor

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Yes, you uncross your fingers . . . you don't take chances . . . when you buy CONSECO Equipment, even when it doesn't cost most! A sweeping statement . . . but we feel our more than 33 years of experience amply justifies it. So does every CONSECO customer. So will you.

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Bulletins on all **CONSECO PRODUCTS** *sent on request.*

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Appointments

Begins on page 187

hurst, Dielectrics Section. **Measurement Control Devices:** P Cherkas, president. **The Thompson-Ramo-Wooldridge Products Company:** W S Aiken, director of engineering.

The Vapor Recovery Systems Company: R V Long, president and general manager; H Dickinson, corporation vice-president. **Youngstown Sheet and Tube Co:** Dr H N Lander, assistant director of research.

Engineer changes

Allis-Chalmers Mfg Co: G L Fox Jr, D R Roberts Jr—Power Dept. **General Electric Company:** A G Mellor, M M Patterson—Power Plant Operating Div. **I-T-E Circuit Breaker Co:** Dr E W Boehne, consulting engineer, research and development. **Beckman Instruments, Inc, Scientific Instruments Div:** R L Solnick, chief project engineer.

Walter J Braun

Nuclear Science and Engineering Corp adds W J Braun to its Industrial Applications Dept. In his new position Braun will take charge of the dept's work on determining engine and engine-parts wear by radioactivity.

Formerly Braun worked on peaceful uses of atomic energy at Battelle Memorial Institute. He developed the first radioactivation of a large diesel-engine cylinder liner to determine liner wear. He's also done wear rate studies on engine rings, turbojet fuel nozzles and other small engine parts. An important design of his is a neutron shielding device for activating selective metal surfaces.

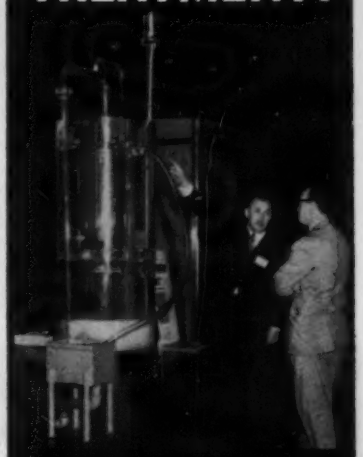
New names

Alnor Instrument Co, Div of Illinois Testing Laboratories, Inc: new name for Illinois Testing Laboratories, Inc. **Devcon Ltd:** Canadian company to manufacture plastic steel and other industrial maintenance, repair and tooling products. **Goulds Pumps International, Inc:** will handle all export sales of Goulds Pumps, Inc.

continued

BE "IN THE KNOW" ON

WATER TREATMENT!



Is good boiler housekeeping in your plant beset by sludge, scale and corrosion? Are these enemies of efficiency increasing downtime and maintenance costs, fighting company profits and your own career?

The Power Show can help you find better ways to fight back. It can help you keep your company's profits growing and your own job on the upgrade by keeping you up-to-date on water softeners, demineralizers, dealkilizers, filters, deaerating heaters and clarifiers — PLUS a broad line of other power and allied equipment.

Only at the Power Show do you have the opportunity to investigate, compare and get the right answers, face-to-face, from the manufacturers themselves. Only at the Power Show can you see over 250 leading suppliers' products, all conveniently grouped together at one time.

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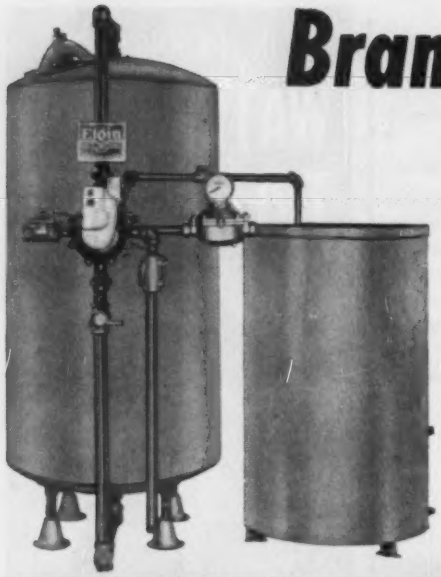
Brand new AUTOMATIC WATER SOFTENER



Joins the Elgin Line ...at a new low, low price

This brand new Elgin Automatic Water Softener employs the Elgin time-proved multiport valve with simple, and therefore dependable, motorized lift-turn mechanism.

This simplicity of design not only gives it dependability of operation, but also permits selling it at a low, low price despite the fact that it is built to traditional Elgin quality standards.

Like all Elgin Water Softeners, this new automatic is also available in the revolutionary "Double-Check" design described below. Now more than ever before it will pay you to get a quotation from the Elgin man before you buy.

Available in Elgin "Double-Check" design

Yes, this new automatic—and the softeners with the two other controls described opposite—are available in the "Double-Check" design which gives these money-saving features:

1. Zeolite locked in . . . prevents costly replacements.
2. Being locked in, zeolite can be backwashed more thoroughly without loss . . . to keep softener clean, efficient, long lived.
3. Clean, receptive zeolite bed, plus highly efficient brine distributing system, means complete regeneration with marked salt savings.
4. Deeper zeolite bed of "Double-Check" softener gives far greater softening capacity from given size softener or equal capacity from smaller one.

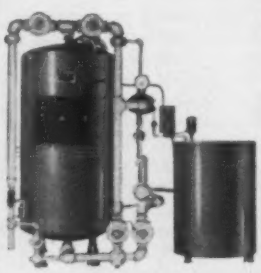
Ask for Bulletin 615

Complete facts about Elgin softeners and other equipment listed below are given in Bulletin 615. It is yours for the asking. So too are the services of the nearest Elgin representatives. They are listed in the yellow pages of phone books in principal cities under "Water Softening & Treatment."

Choice of two other outstanding controls

MANUAL MULTIPORT

Thousands of water softeners with the manual multiport valve control attest to its excellent performance and rugged construction. All operating steps are controlled by one simple revolution of valve handle.



HYDRAULIC ULTRAMATIC

For those who want the finest in automatic operation, this hydraulic "Ultramatic" is the answer. Its time-proved hydraulic valves and automatic pilot give the ultimate in dependability and control.

ELGIN
WATER CONDITIONING
SINCE 1908

ELGIN SOFTENER CORPORATION
130 N. Grove Avenue, Elgin, Illinois

Representatives in principal cities • In Canada: G. F. Sterne & Sons Ltd., Brantford

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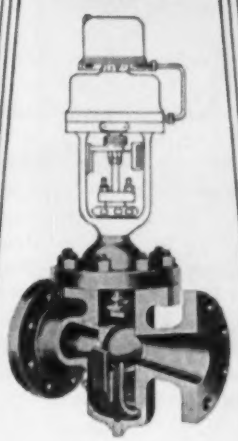
General Kinetics Corp.

HIGH FLOW CAPACITY...

6"
P-K PAUL VALVE
Equals
8" GLOBE VALVE
IN VOLUME OF FLOW



The high flow capacity of P-K Paul Control Valves is one of their most outstanding features. Based on a unique Venturi ball design, these valves offer **straight through non-turbulent flow.** They are self-purging and handle slurries and fluids containing suspended solids without difficulty. They are **highly resistant to erosion and wire drawing, minimize flashing and cavitation problems, and are virtually unaffected by temperature.** The ball-seat feature provides positive **shut-off, greatly increased valve life, greater stability and wide rangeability.**

Write today for technical catalogue

197 SOUTH VAN BRUNT STREET
General Kinetics Corp.
ENGLEWOOD, NEW JERSEY

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Appointments

Begins on page 187

Kaiser Engineers International: new name for Heavy Construction Div of Henry J Kaiser Co to handle firm's engineering and construction activities outside the U.S. and Canada. **Meteo Inc:** new name for Metallizing Engineering Co. **Nuclear Technology Corp:** nuclear consulting firm covering nuclear analysis, design and evaluation.

John E Gray

Nuclear Utility Services, Inc, a new firm which will help electric-utility companies plan and operate nuclear-power plants, has been formed by a group of leading nuclear engineers and scientists. Included in this group is J E Gray, the engineer who directed design and construction of the pioneer Shippingport Atomic Power Station and coordinated all atomic-power activities for Duquesne Light Company. Gray, president and chief executive officer of the new company, guided Duquesne Light Company's activities on the Shippingport nuclear power plant for the past six years. He has been associated with General Electric Company and Westinghouse Corp and served as AEC's technical and manufacturing director at Savannah River (H-bomb) Plant.

Frederick H Warren, board chairman, is a partner of Packard-Warren-Lowe Associates and former deputy director of the Construction and Supply Div of the AEC. He is former

WHAT'S BUILDING UP IN

PUMPS AND COMPRESSORS?

Often regarded as the "heart" of a system, pumps and compressors merit frequent re-evaluation to determine that you are using the right machine for a specific application.

Listening to the "heartbeat" of pumps and compressors can best be done at the Power Show, where you can ask questions, investigate and compare, get first hand answers from the manufacturers themselves. There you'll also see a broad line of other power and allied equipment.

At the Power Show you'll be in direct contact with manufacturers, enabling you to get specific, direct, authoritative answers to your questions. Only at the Show will you see more than 250 leading suppliers' products, all conveniently grouped together.

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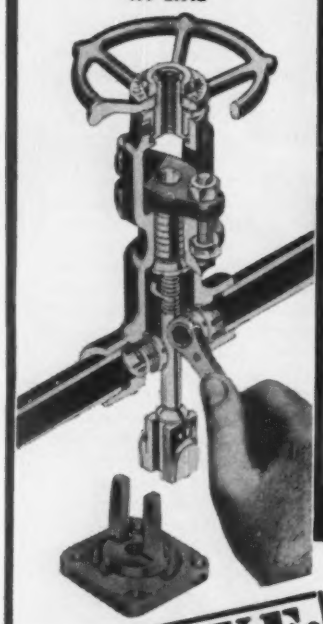
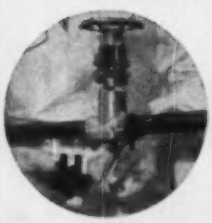
SPECIFY:
VELAN
BONNETLESS
FORGED STEEL
GATE VALVES

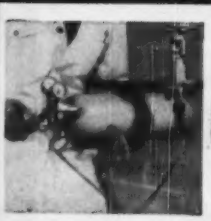
*Patented U.S. 2,905,192

FULLY SERVICEABLE
IN LINE





CLEANED OR FLUSHED
IN THE LINE



TESTED FOR TIGHTNESS UNDER
PRESSURE OR DURING SHUT-DOWN

SAVE:
LONG-RANGE COST 70%
MAINTENANCE 50%

For new valve designs
SEE BOOTH NO. 49 at the POWER SHOW—Coliseum, New York City

PRODUCTS OF
VELAN'S CREATIVE ENGINEERING
FOR POWER PLANTS
Write to VELAN Companies in
BEEKMANTOWN ROAD, PLATTSBURGH, NEW YORK
2125 WARD AVENUE, MONTREAL, CANADA; ROSS WALK, LEICESTER, ENGLAND

Appointments

Begins on page 187

executive-vice-president assistant for atomic energy of General Dynamics Corporation.

Dr Warren F Witzig, vice-president and technical director, was responsible for the final nuclear-design stages of the *Nautilus* and designed nuclear reactors for the *Skipjack* series of submarines.

Associated with the new firm as senior technical consultants are Dr Mason Benedict, head of Dept of Nuclear Engineering at Massachusetts Institute of Technology; N J Palladino, head of Nuclear Engineering Dept at Penn State U; Dr Stuart McLain, former associate director of Argonne National Lab.

Purchases & Mergers

Barry Controls, Inc: merger with The Wright Line, Inc as Barry-Wright Corp. **All-State Engineering Co:** acquisition of Borg-Warner Industrial Crane & Hoist. **Miniature Precision Bearings, Inc:** acquisition of Carter Engineering Co. **Phelps Dodge Copper Products Corp:** acquisition of Edlen, Inc. **Taylor Fibre Co:** acquisition of Dytronics, Inc. **Electric Storage Battery Co:** purchase of Thomas A Edison Industries storage battery unit of McGraw-Edison Company.

Awards

J B Adams, acting director of CERN and director of CERN's proton synchrotron div, the Roentgen prize from the Justus Liebig University of Germany. **S D Bechtel,** president of Bechtel Corp, the John Fritz Medal for his work in the construction industry. **Dr G H Keulegan,** Fluid Mechanics Section of National Bureau of Standards, and **Dr C H Page,** consultant to the director of National Bureau of Standards and chief of Electricity Div—U.S. Dept of Commerce Gold Medals for Exceptional Service.

Institute elections

Alloy Casting Institute: J D Hagans, sales manager for the Ohio Steel

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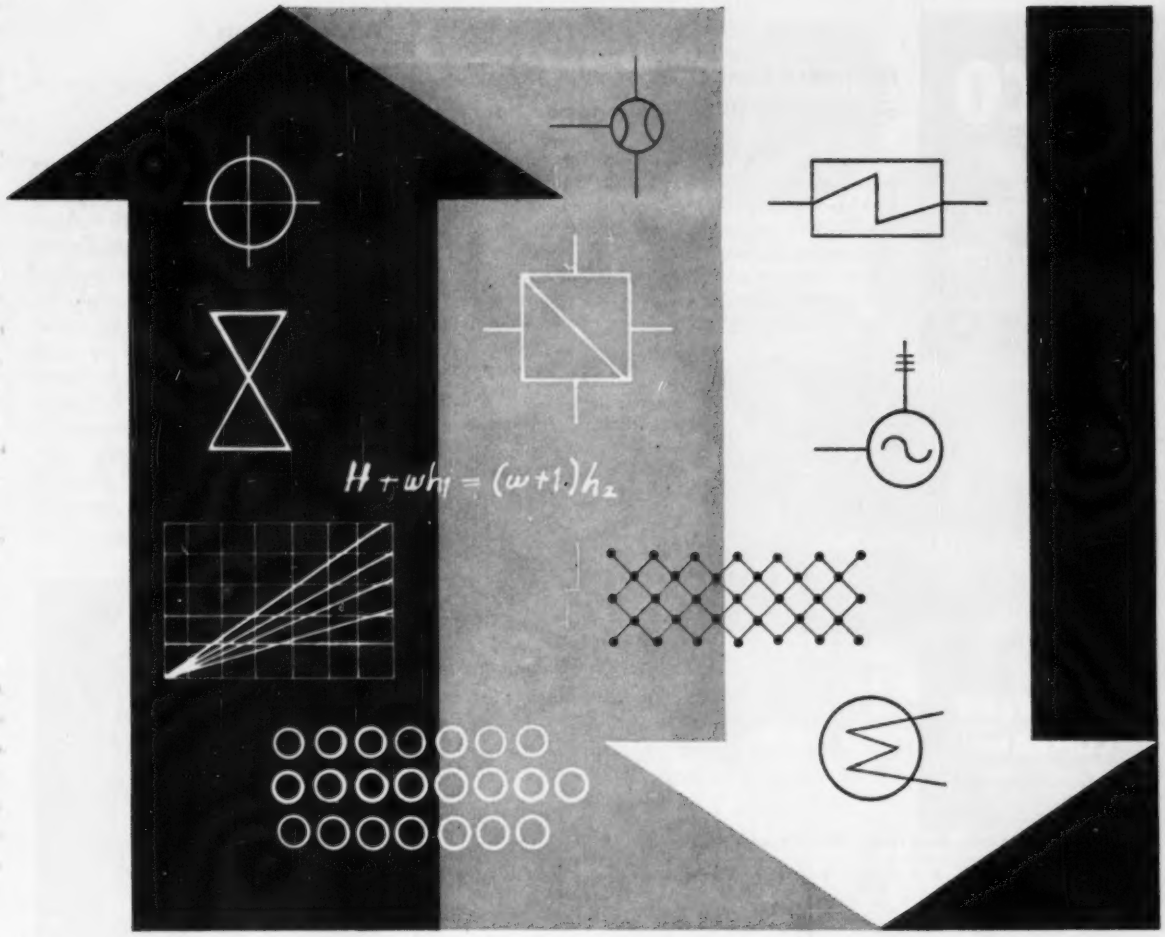

CONTINUING LEADERSHIP IN VITAL RESEARCH

What happens during the start-up and shut-down operations of power plant condensers? Do you know what sources of oxygen contamination exist in the cycle? How can the oxygen in a proposed installation be eliminated without special and costly equipment?

These are but a few of the questions answered in the free 16-page report entitled "Trends in the Design of Deaerating Condensers" published by the Research and Development Division of C. H. Wheeler.

C. H. Wheeler research has led to the ultimate in the design of deaerating condensers and we are constantly looking for better materials and designs for auxiliary power plant equipment.

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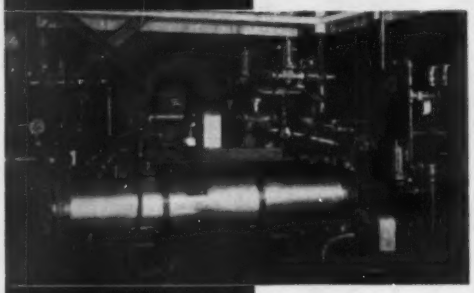

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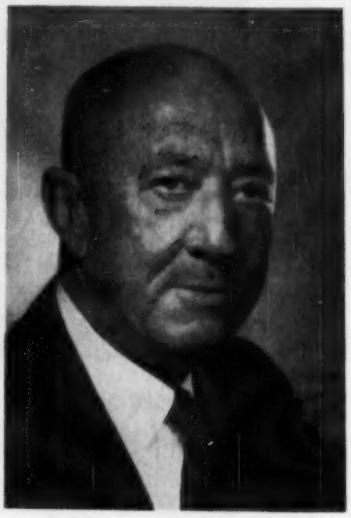
Appointments

Foundry Co, president. **Controllers Institute:** B A Johnson, treasurer of New England Gas and Electric Association, vice-president. **Fluid Power Society:** F L Mackin, chairman of Engineering Shops of General Motors Institute, president; W Ernst, vice-president and director of engineering of Commonwealth Engineering Co, vice-president; A E Morris, editor of *Hydraulics and Pneumatics*, treasurer; B Rogers, executive vice-president and secretary, National Fluid Power Association, executive vice-president and secretary.



Mathew M Gouger

Frick Company's director and executive vice-president was former president of DataGraphic Systems Inc and vice-president of General Aniline and Film Corp. A native Texan, Gouger graduated from the University of Texas. He is a member of the American Management Association and National Association of Manufacturers.

General sales manager

American-Standard: H W McClure, boiler products dept; J W Hosler. **Atlas Chain & Mfg Company:** J L Reeves, assistant sales manager. **Avnet Corporation:** M V Bunnell. **Cornell-Dublier Electric Corp:** R T Leary. **G-C Electronics Co:** D R Johnson, sales

Begins on page 187

manager of knob and resistor div. **General Electric Company:** L D Creede, manager of export sales—Computer Dept. **H K Porter Company, Inc:** H D Tindall, manager of transformer sales and engineering.

Minneapolis-Honeywell Regulator Co: D K Ridley. **Republic Flow Meters Company:** O W Riggs; C W Marks, assistant sales manager. **United Electric Controls Company:** G W Clapp. **United States Rubber Company, Naugatuck Chemical Div:** A Thomas Jr. **The William Brand & Company:** F Saunders.

Retirements

C R Cary, chairman of the board of Leeds & Northrup Co, after 53 years of service.

S W Fletcher, president of J O Ross Engineering Div of Midland Ross Corp, remaining as director of the company.

F Myers, district manager of Ohio Brass Co's Valve Dept, New York and Eastern area, after 38 years.

J C Siegle, general superintendent of Youngstown Sheet and Tube Co's Tube Div, after 47 years with the company.

Dr H F Stimson, senior physicist in the Temperature Physics Section of Heat Div, National Bureau of Standards.

Obituaries

Eugene H Bird, president of Eastern Gas and Fuel Associates, at the age of 67.

Thomas G Dignan, president of Boston Edison Co. He was 61.

George H Gilman, retired mining engineer and former president of Gilman Mfg Co, at the age of 78.

Louis B McCarthy, vice-president, treasurer and director of Mac-Allen Co, at the age of 63.

F P Rice, director of operations for International Resistance Co. He was 49 years of age.

J S H Wurtele, former vice-president, director of Southern Power Co and president of Dominion Electric Protection Company, Toronto, on Aug 6.

look over...

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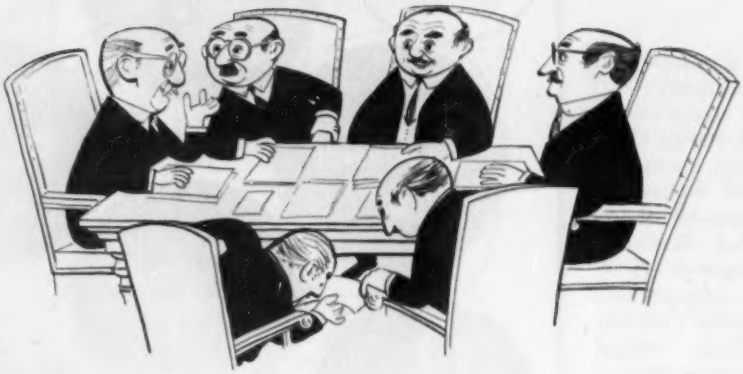


George Edwards

learns that "you can prove anything mathematically"

If you can afford to sped about 15 minutes with a real rib tickler, get hold of a copy of a paper entitled "On the mathematics of committees, boards and panels." Written by Bruce S Old, Arthur D Little, Inc, Cambridge, Mass., it was first published in *The Scientific Monthly*, Aug 1946, p 129. I'm sorry that I didn't get a chance to enjoy it earlier.

Not outdated by a long shot, it's a droll tongue-in-cheek approach to, as the paper puts it, ". . . an analytical study, with a view toward improving, the efficiency of functioning of committees, boards and panels in general."

Some excerpts: "There are numerous methods of expressing mathematically the objective of committees, boards and panels: namely, to perform work. The most commonly applied formulae are the following: Utilization of the familiar time, force, distance relationship where the object is to maximize the expression

$$\text{ComBulPac} = \frac{fd}{t}$$

in which ComBulPac = code name for power output of committees, boards and panels; f, d and t = force, distance and time respectively. This equation was the origin in 1812 of the expression 'a powerful committee.'

"A second and very appropriate method is the use of the gas law as a basis for the work expression. Here the attempt is made to maximize final minus initial gas volume:

$$\text{ComBulPac} = \int_{v_1}^{v_2} pdv$$

in which p = pressure and v = volume.

"Experts hold that Gay-Lussac first evolved from this relationship, 'a high-pressure committee.' On the other hand, there is no foundation for the rumor that the current slang phrase, 'the committee is cooking with gas,' was derived from this equation.

"Another method which is very useful under certain circumstances is: ComBulPac = Le, in which L = fr, f = force, r = radius and e = angle. The reader will recognize this as the well-known 'revolving committee.'

"Perhaps the most fundamental law discovered in this paper is:

$$I = \frac{E}{R} \text{ (Old's Law)}$$

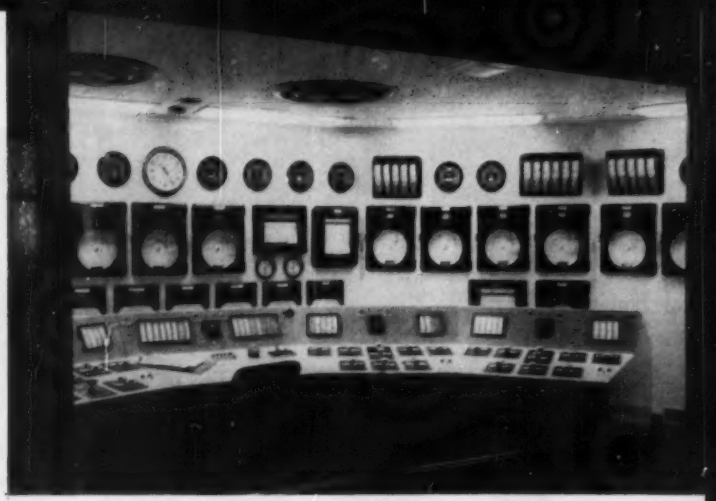
in which I = intelligence in any given subject, R = rank of individual and E = a constant of very small magnitude of the order of 1/c, where c is the velocity of light. This indicates that E has the dimensions of a wave 'slowness.'

"There is little deviation from the law except at the extremities. (In this regard it maintains its similarity to Ohm's Law I = E/R.) It follows that it is a simple matter to deduce the fact that if one desires to form a committee with high efficiency of work output, it is essential to select working-level personnel."

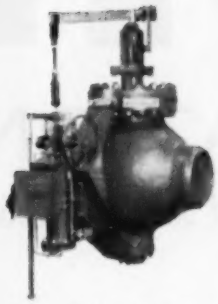
There's much more than space permits, but here are Mr Old's conclusions: "The lack of correlation in this paper is regretted. It may be that the choice of parameters was completely unsound. One point which completely baffles the author is the peaking of the efficiency of output of a committee vs number of committee members at seven-tenths of a person. Obviously one must conclude that either further research is required or that people are no damned good." Thus Mr Old mathematically proves *snafu*.

ROCKWELL-REPUBLIC

INSTRUMENTS, CONTROLS, AND VALVES



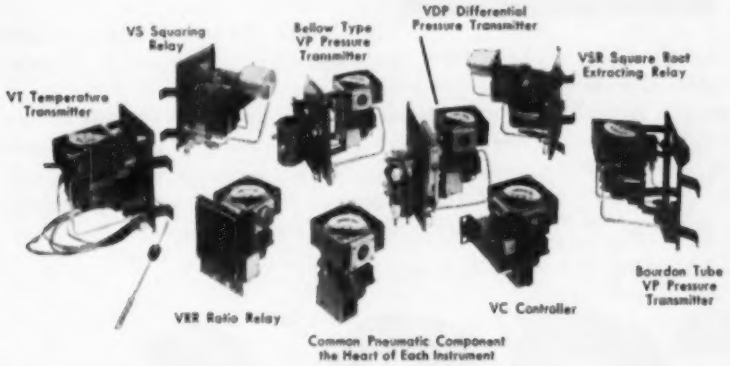
Rockwell-Republic Control Systems. Republic engineers and furnishes equipment for both electronic and pneumatic control systems, for use on large central stations, package boilers, process industries, and steel mills. Republic has installed more than 125 electronic control systems since the first one in 1949. They total more than 400 unit-years of operation. These central systems automatically control steam pressure, combustion, furnace pressure, excess pressure, boiler level, and other variables.



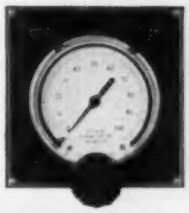
Steam Dump Valve. Series 700 double-seat valve (600 psi) with Series 73 positioner. Valve shown used in nuclear power plant to dump steam to condenser when steam must by-pass turbine.

Quick-Change Trim V-10 Valve. For severe services up to 4500 psi, newly improved regulating valve features quick-change trim that allows dismantling and reassembly within minutes without removing valve from line.

Improved Final Drive Unit. Operates valves, dampers, inlet vanes, etc., in response to either pneumatic or electronic signals from remote control station. Can also be operated manually. Power is pneumatic.


VS Squaring Relay
Bellow Type VP Pressure Transmitter
VDP Differential Pressure Transmitter
VSR Square Root Extracting Relay
VT Temperature Transmitter
Bourdon Tube VP Pressure Transmitter
VRR Ratio Relay
VC Controller
Common Pneumatic Component the Heart of Each Instrument

Null-Balance-Vector Pneumatic Instruments. When used with each other, Rockwell-Republic null-balance-vector instruments offer the special advantages of a high rate of inter-changeability of parts and simplified training requirements because a common pneumatic component is used throughout the line.



M/A Control Stations. Republic offers a complete line of compact, panel mounted control stations for use with Null-Balance-Vector instrument control systems. These control stations are made in several types to accommodate a wide variety of pneumatic control applications.

In addition to the above items, a complete line of Rockwell-Republic instruments and controls including Desuperheaters, Electric Transmitters, Flow Meters, CO_2 meters, valves, and others is available. Write to Republic Flow Meters Company, Subsidiary of Rockwell Manufacturing Company, 2240 Diversey Parkway, Chicago, Illinois.

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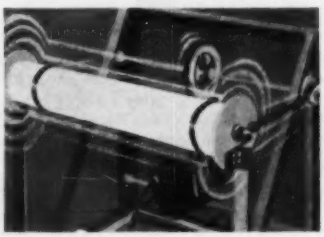

Zebra is made in half sections even for the larger pipe sizes... for faster application with fewer joints. Despite its rugged, full body, it's relatively lightweight... easy to cut and fabricate. It's a low, medium and high-temperature multi-layer sectional-type thermal insulation. And it meets your requirements for density, conductivity, modulus of rupture, and resistance to soaking heat. Write today for more information and a free sample of new "K&M" Zebra. It's tough, economical, fast to apply. That's Zebra... by K&M! Keasbey & Mattison Company, Ambler, Pa. Dept. I-1110.

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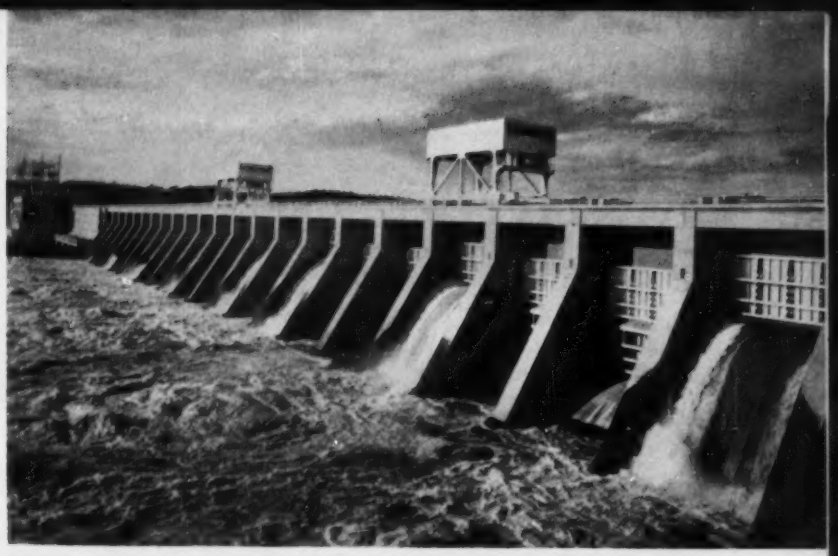
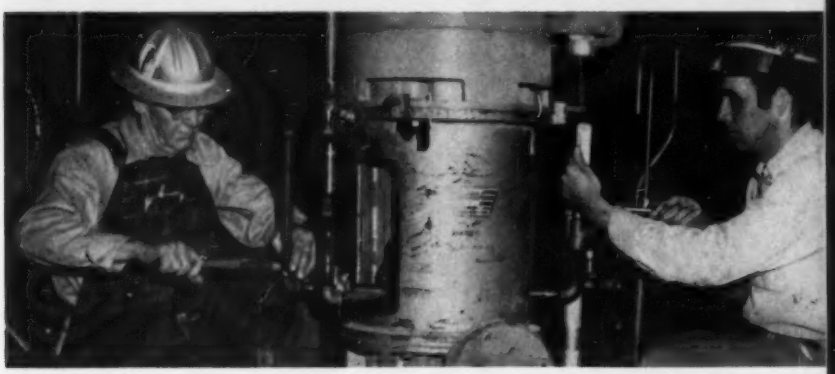
Plant maintenance and management section

STEVE ELONKA
Associate Editor in Charge



Water power and steam generation call for . . .



Skilled mechanics and operators turned out by . . .

TVA apprenticeship program

By JAMES P MITCHELL
Secretary of Labor

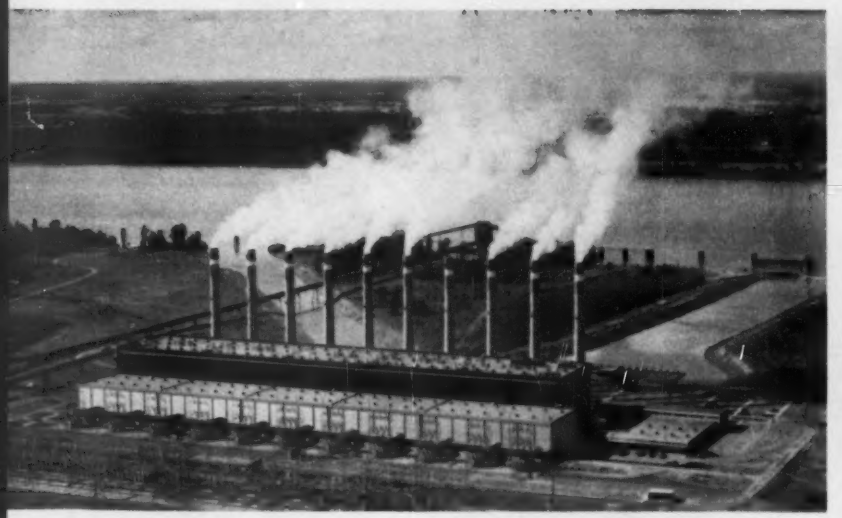
During the next 10 years 29,000,000 new workers will be needed to produce goods and services for our increased population of 208,000,000, 28 million more than the 1950 census figure. If we plan well and use our manpower wisely we can increase our standard of living by 25 percent in this decade. This calls for an increase in goods and services of 50 percent or $750 billion annually for the next 10 years.

Number of workers under 25 years of age will increase by nearly 6½ million or 46 percent by 1970. Workers 25 to 34 years of age will increase by only 1¼ million. Those between 35-44 will decline by 200,000. But this is the age group from which foremen, supervisors and middle management are usually drawn. Workers over 45 will continue to increase by 20 percent to 5½ million. Women workers will increase by 25 percent.

The '60's will see the greatest growth in jobs for professional, managerial, clerical, sales and skilled workers. We anticipate no change among unskilled laborers and a continuing decline among farmers and farm workers.

With some 2,150,000 persons on government payrolls in this country, the federal government must devote more time to training needs.

Tennessee Valley Authority offers an example of federal-agency training. This agency, employing 14,800, initiated an apprenticeship program in the '30's. TVA harnessed the Tennessee River and its tributaries with a system of



TVA'S SHAWNEE STEAM PLANT on Ohio River near Paducah, Ky. has ten units totaling 1,500,000 kw. Plant supplies power to new Atomic Energy Commission installation

MACHINIST APPRENTICE gets on-the-job training by working with journeymen

By 1970, 46% more workers will be needed in this country

dams to control the flowing water. Electrical power is being generated in both hydro and fuel plants. It believes that a sound basis for collective bargaining and employee management helps do the job better. Employees are encouraged to organize for this purpose.

In 1935 TVA in its Employee Relationship Policy looked to the promotion of education and training as a desirable subject for joint conference between labor and management. In 1937 apprenticeship was adopted as the only channel for attaining journeyman status in TVA. Since then 2327 apprentices have been enrolled in these crafts: auto-body repairing; boilermaking; bricklaying; carpentry; cement masonry; electricity; equipment, gas, diesel and instrument mechanics; iron working; construction and maintenance line work; machining; office-appliance repairing; operating engineering; painting; plumbing; sheet-metal working; steamfitting; and substation electrical work. A total of 1357 apprentices completed their training.

Valley-wide joint council developed and established uniform apprenticeship standards. General agreement between TVA and the Tennessee Valley Trades and Labor Council provided: "An adequate system of apprenticeship shall be established and maintained for employees of TVA. A Central Joint Council on Apprenticeship shall be maintained for this purpose, consisting of an equal number of representatives of TVA and the Council." Completing their training, apprentices receive both a TVA certificate and one from the Bureau of Apprenticeship and Training of the U.S. Department of Labor.

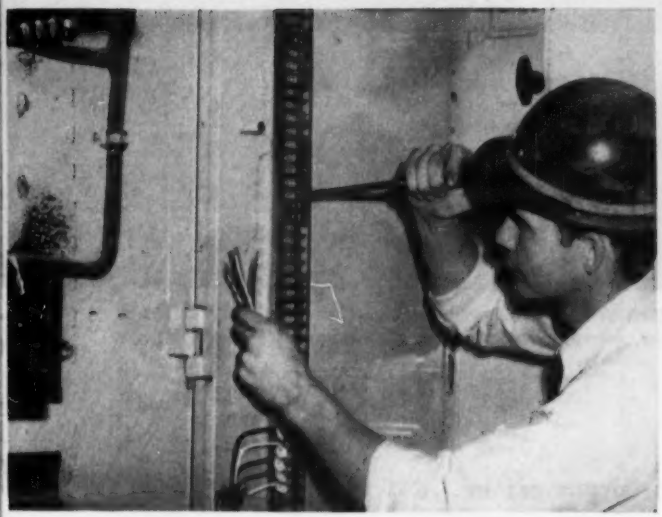
TVA trys to select apprentices from their own employees. Qualifications: They must be at least 18 years of age. Average age for new, inexperienced apprentices is 24 years, for those granted time for past experience, 28 years. These ages do not apply to veterans. High school is desired, but at least six grades of elementary school or its equivalent is a must and a passing score must be made on a qualifying test. Applicant must be in good physical condition and have approval of the local Division of Health and Safety.

The General Aptitude Test Battery is used for testing applicants for this program. This is composed of 12 tests covering nine different aptitudes: general learning ability, verbal aptitude, numerical aptitude, spatial aptitude, form perception, clerical perception, motor coordination, finger and manual dexterity. Research determines minimum required scores and aptitudes for the various crafts. Applicant can take the test only once but there is no limit for the number of crafts for which he may apply. Successful applicants are then on call.

Apprenticeship is divided into four periods of training. As an example, the boilermakers' program has a total of 8000 hours of on-the-job training, shown in the chart at right. Shortest program is for iron workers, 4000 hours, and the longest for substation maintenance-electricians, 11,000 hours.

On-the-job training accounts for 90 percent of total training time. During this time apprentice acquires job knowledge and skills by doing productive work. Craft subcommittees develop craft analyses giving the job processes involved and the number of hours to be worked on each to learn it. During first three periods, apprentice works under the journeymen. He is rotated among various journeymen during apprenticeship. In the fourth period he is under general supervision so he receives experience in layout and job planning. He can also do journeyman-grade work on his own initiative.

Related training that cannot be obtained through



ELECTRICIAN APPRENTICE learns to do by doing. Here he installs control wiring on an operating control board at Widow Creek

Boilermaker craft analysis and time-allotment outline

	Job processes	Hours
I	Blueprint reading, layout and detail work	1000
	Shop and office detail work 500	
	Field layout and detail work 500	
II	Welding	1000
	Electric arc	
	Acetylene welding, burning	
	Preheating, stress relieving	
	Stud shooting	
III	Boiler erection	4900
	Tube rolling	
	Align furnace walls, headers	
	Erect air preheaters	
	Erect condensers	
	Erect boiler casing	
	Other equipment, etc	
IV	Rigging	1000
	Hooking	
	Signaling	
	Hoisting	
	Cable splicing	
	General rigging, etc	
V	Boiler maintenance and testing	100
	Total hours	**8000**

work experience is given. This covers technical information needed in the craft. The apprentice is required to attend classes in related training for a minimum of 144 hours per year. But when class instruction isn't practicable, apprentice may take correspondence courses of 144 hours of study—prepared by training officers.

This training includes lectures, demonstrations, blackboard work, discussions, visual aids, lessons, drawings, problems and tests. Instructors are usually craft journeymen or foremen, elected by the craft subcommittees. Correspondence training is more limited in that the apprentice completes his lesson assignments individually. But he may obtain help from journeymen and foremen. His lessons are graded by the craft subcommittees.

An outline of related training is prepared for each craft. Subject areas and time requirements during each year of apprenticeship: shop sketching and blueprint reading, 36 hours; mathematics, 36 hours; trade science and theory, 54 hours. Nontechnical subjects, taking up 18 hours, round out the program.

Craft subcommittees determine if apprentices are qualified for promotion by testing at the end of each period or when desirable. Examinations are given by instructors in the classroom, or by subcommittees for correspondence courses. On-the-job training is usually tested by having the apprentice demonstrate his knowledge and skill on a practical job.

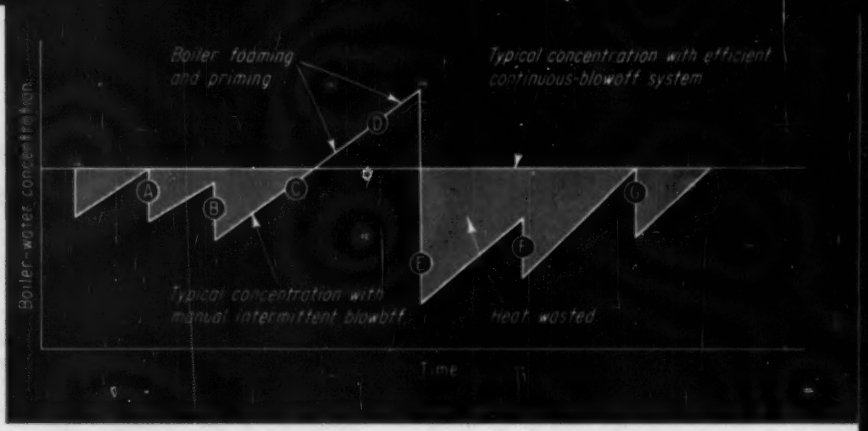
TVA has from time to time made a number of research studies on its apprenticeship program. As a result it has improved the program and kept it up to date. In 1956 it made a study of costs and credits of TVA trades and labor training for fiscal 1955. This revealed that the value of the productive work of an apprentice was greater than the cost of training. As of Oct 1960, total apprentices enrolled numbered 2344 and those presently in training 139. Total completing training was 1370 or 62.1%.

Effectiveness of apprentice training in TVA: 24 percent of 1015 former apprentices advanced to supervisory positions ranging from subforeman to construction superintendent. This showing speaks for itself.

Since 1936, TVA has demonstrated the advantages of apprenticeship conducted by joint union-management cooperation. It has assisted private industries and other agencies to develop and improve apprenticeship through contributing its experience and materials. In 1953 the International Association of Bridge, Structural and Ornamental Iron Workers adopted the TVA construction ironworker program to recommend to local unions as their national standard. Materials on TVA apprenticeship programs have been sent to private industries, international unions and government installations all over the U.S. and many foreign countries. TVA has even received foreign nationals who wished to observe training procedures.

This program is a fine sample of what a well-thought-out training program can mean to management, the individual, community and the nation as a whole.

By HOWARD B FRANCE, Mgr
Deaerator & Steam Specialty Div
Cochrane Corporation



BOILER-WATER CONCENTRATION varies erratically with manually controlled intermittent blowoff. Heat energy is wasted by having lower concentration than necessary

Heat recovery economics leave no room for argument in . . .

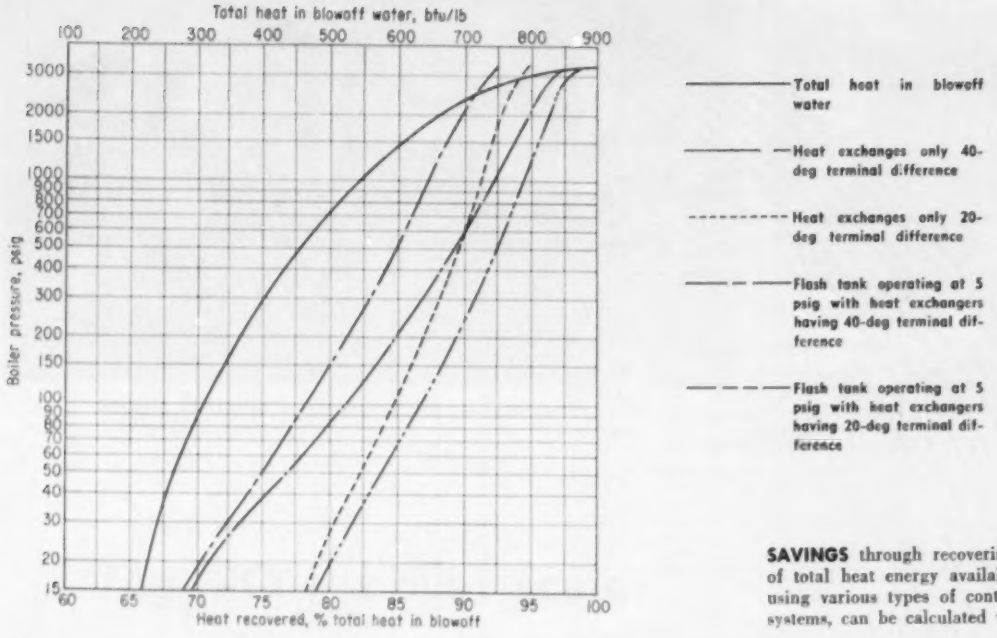
The case for continuous blowoff

Maximum permissible concentration

Boiler pressure, psi	Total dissolved solids, ppm	Alkalinity, ppm	Silica, ppm
100 200	3500	700	
300 400 450	3000	600	50
500 600	2500	500	
700	2000	400	35
750			20
800 900	1500	300	10
1000	1250	250	5
1100 1200 1250	1000	200	3
1300 1400 1500			2
1600 1700 1800 1900 2000	750	150	1
over 2000	500	100	

Everyone will agree that boiler feedwater contains impurities in varying amounts, depending upon purity of the return condensate, source of makeup water and type and quality of makeup-water treatment. As water evaporates into steam the concentration of impurities in boiler water builds up continuously because the impurities do not normally carry over with the steam. Unless something is done to prevent such continuous buildup, the resultant concentration of impurities would exceed tolerable limits after a short period of boiler operation. Boiler's tendency would be to foam and prime, deliver impure steam by resultant carryover of concentrated boiler water. Under such conditions operation would be, to say the least, highly unsatisfactory. To forestall such conditions by controlling their initial cause—overconcentration of impurities—boilers are "blown off."

Impurities which must be controlled are, in the main, dissolved solids, alkalinity and silica. Boiler manufacturers usually specify the maximum concentration of these im-



SAVINGS through recovering percentages of total heat energy available in blowoff, using various types of continuous blowoff systems, can be calculated with this chart

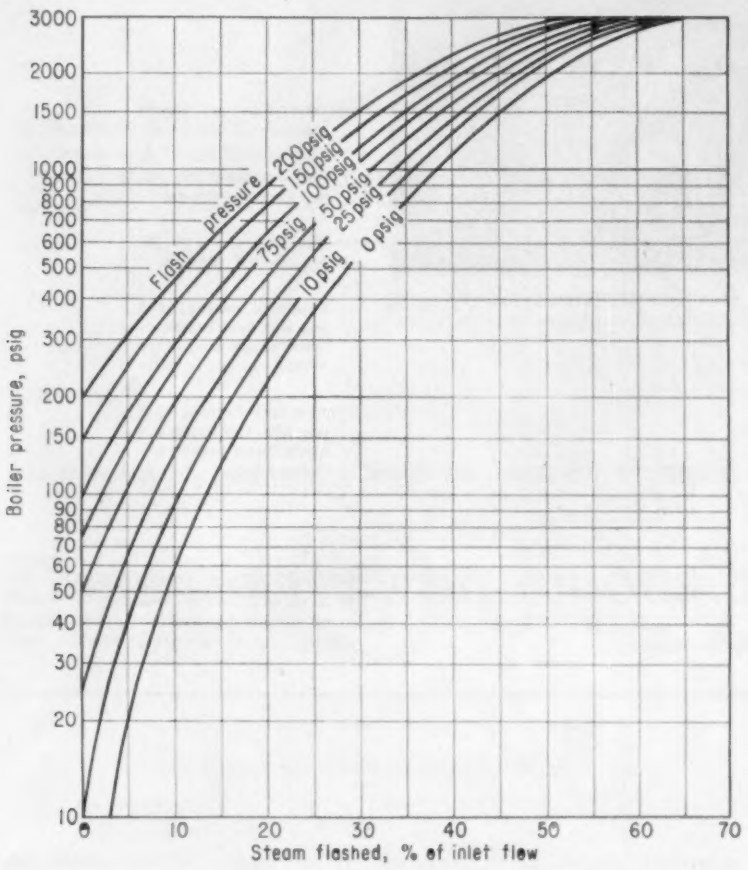
purities permitted if their units are to continue to perform satisfactorily. Normally acceptable concentrations at various boiler pressures are shown in table, left.

Two methods are available for controlling boiler-water concentration. First method, and most common in the past, is intermittent blowoff. With this method impurities in boiler water are allowed to build up until maximum tolerable concentration is reached. At this point a blowoff valve located at the lowest point in boiler-water circulation is opened manually and a large quantity of boiler water loaded with impurities is discharged to waste.

Continuous blowoff is second method. With this, impurities in the boiler water are maintained constant at the maximum permissible level by continuous blowoff of relatively small quantities of water. With intermittent blowoff a large quantity of water may be blown off infrequently or a smaller quantity more frequently as shown graphically, above left. Concentration of impurities in boiler water immediately after blowing off is inversely proportional to amount of water blown off. Note that as blowoff frequency increases, amount of water blown off decreases. This occurs until with continuous-blowoff conditions boiler-water concentration becomes constant and amount of water blown off reaches an irreducible minimum. Immediate advantage of this latter condition is that heat lost with blowoff water is cut to a minimum.

Boiler-water concentrations with intermittent manual blowoff under ideal conditions are represented by the left side of the graph. But, considering human frailties, concentrations will frequently take the appearance shown by the right side of the graph. This indicates erratic variations caused by untimely excessive or inadequate blowoff. This points up a second advantage of continuous blowoff: boiler-water concentration is held constant at optimum levels. The graph indicates that point *A* is normal blowoff when concentration reaches allowable maximum. Point *B* also represents normal blowoff, but unnecessarily soon. This is a common source of heat loss. At point *C* we see another all-too-common situation; the operator has failed to blow down on schedule. Point *D* is the natural result of *C*. Boiler-water concentration is much too high. Boiler is foaming and possibly priming with excessive carryover probable. Next we have excessive blowoff, point *E*, with costly heat loss resulting in unusually low boiler-water concentration. At point *F* we're back to normal blowoff at normal time. But the boiler water hasn't yet reached maximum concentration. This means more heat loss. At point *G*, we're back to normal blowoff on schedule.

Intermittent blowoff usually involves rapid discharge of a large quantity of high-temperature water with little chance to recover this heat energy. If heat-recovery equipment was installed it would operate on an on-off basis and would have to be sized for the maximum instantaneous rate of blowoff. Such equipment would necessarily be bulky (and apt to be costly). It would probably be difficult to find a profitable use for heat which would be recovered intermittently. This brings us to a third



FLASH-STEAM utilization puts recoverable heat energy back into cycle. Chart shows amount of steam released by flashing at various boiler and flash-tank pressures

advantage of continuous blowoff in that it ties in with economical heat recovery.

Heat recovery means fuel cost savings to an extent which permits amortization of continuous-blowdown and heat-recovery-system equipment in a relatively short time—sometimes within one year. With such a system heat energy may be recovered by two methods: (1) utilization of flash steam and (2) heat transfer from blowoff to makeup or process water in heat exchangers.

Utilizing flash steam can mean significant savings. When high-temperature boiler-blowoff water is admitted to a flash tank at reduced pressure, steam is released, becoming available for plant purposes such as deaeration and feedwater heating, building heating, process or other uses. The remaining unflashed water at reduced temperature and pressure may be passed through a heat exchanger in which the water's residual heat is transferred to another media. Such a system has these advantages:

(1) Flash steam is returned to the feedwater system where all of its heat content and moisture are recovered. It also reduces to a degree the total amount of makeup water, thus helping to reduce amount of impurities which make blowdown necessary in the first place.

(2) Required heat-exchanger size is reduced since most of the heat energy and moisture have been recovered in the flashed steam.

(3) Entire system need only be designed for flash-tank pressure rather than for boiler pressure.

(4) A single flash tank and heat exchanger can be used with several boilers.

Charts on pp 203 and 204 show, respectively, amount of heat recoverable from total heat in blowoff with various continuous-blowoff systems and amount of steam released by flashing at various pressures.

Since quantity of steam flashed from blowoff water reduces quantity of water discharged to waste which in turn reduces makeup requirements, it's obvious that there will be less makeup water to buy, to treat and to pump. Manpower savings are involved, too. As a general rule, once the rate of continuous blowoff is set for normal operating conditions such a system is automatic. Operating personnel, freed from the periodic task of manual intermittent blowoff, can give more attention to other duties.

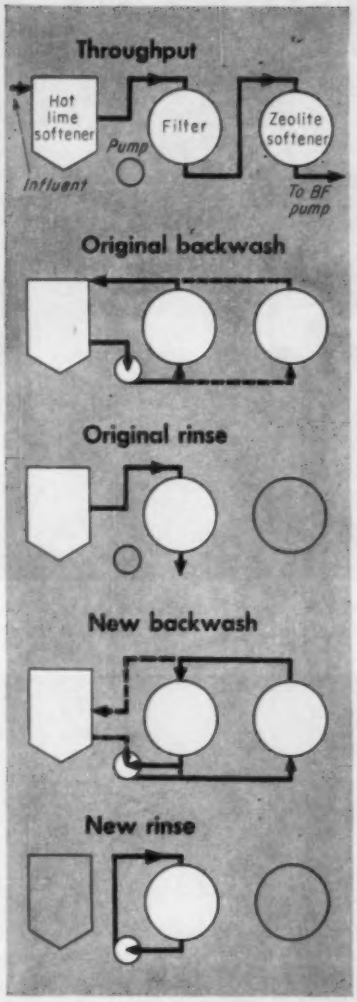
This month, we've discussed the advantages of the continuous-blowdown-system concept. Next month we'll discuss the ways continuous-blowdown systems can be fitted into the heat cycles of new or existing plants and to some extent analyze equipment choice and its application.

ZEOLITE SOFTENER is backwashed by output of both filters. During filter rinse, water is recirculated back to filter inlet

$Mg_3(PO_4)_2$ boiler scale traced to treatment plant operation

Contamination of zeolite-softener supporting bed led to incipient boiler scale. Backwash and rinse changes nipped it and saved water

By F E ZIEGELMANN, Refrigeration Service
Meadow Vista, California



NEW BACKWASH AND RINSE method eliminates magnesium-phosphate deposit

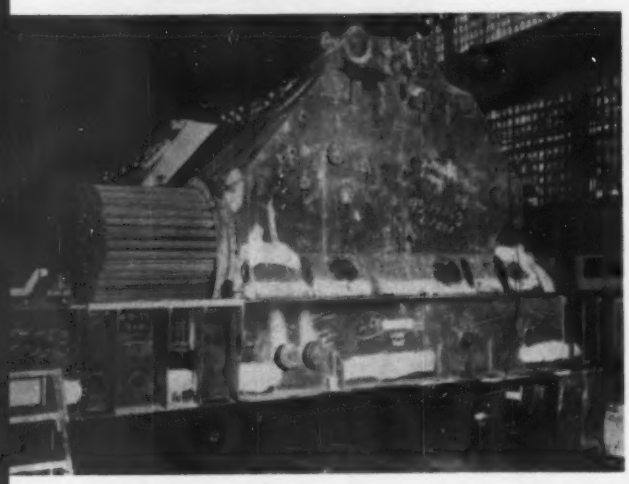
Delco-Remy Div in Anaheim, Calif. operates two 14,000-lb-per-hr gas-fired boilers rated 250 psig to make process steam. Filters and zeolite softeners capable of producing 60-gpm treated water follow 45-gpm hot-lime softener to complete the picture. Original installation with throughput, backwash and rinse, above, operated all right for about one year. Then, a slight deposit of magnesium phosphate started to form in boiler tubes and drums. Since zeolite softeners were supposed to take out practically all the magnesium, they were first suspect. But there was no channeling through the filters and a careful check on their operation acquitted them fully. So we looked elsewhere.

Only other way magnesium could get through to the boilers was by contamination of zeolite-softener supporting beds during backwash. Procedure called for pumping lime-softener effluent back through zeolite softener and filter. Filter rinse water was then wasted. So backwash and rinse lines were repiped, shown above. Filtered water now recirculates to backwash the zeolite softener, and filter backwash returns to lime softener in the deaerated storage compartment. Filter rinse was revised to eliminate wasting of water and its heat by recycling.

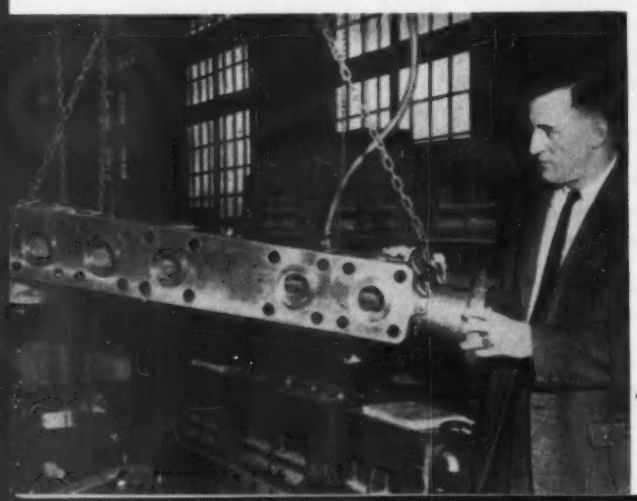
Deposit formation has been stopped for over a year now and filter capacity has proved sufficient to backwash zeolite softener when both filters are run together. Side benefits resulting from this revision in plant operation: softener runs are longer and they can be backwashed until effluent is crystal clear—something not possible with our original setup.

When this article was written, Mr Ziegelmann was associated with the Delco-Remy Div of General Motors Corp, Anaheim, California

NI-VEE bronze valve stems replaced manganese-bronze parts that failed from dezincification, a form of galvanic corrosion



COPPER-NICKEL tubing in this main condenser is for one of the latest atomic submarines. The 70-30 alloy withstands salt water



NICKEL ALUMINUM bronze is tougher than comparable G bronzes, red brasses, leaded bearing bronzes, yet machines easily

OPERATORS' NOTEBOOK **143**

By STEVF ELONKA, Associate Editor

Copper-base alloys: where and how to use them

Copper-nickel alloys are copper base with nickel contents of 2.5% to 30%. The 70%-Cu 30%-Ni alloy and the 90%-Cu 10%-Ni alloy are the most widely used. Their outstanding qualities: (1) good resistance to corrosive and erosive effects of high-velocity sea water and (2) strength at high temperatures. They also have excellent resistance to fresh-boiler-feedwater and steam corrosion.

Important use of copper nickel is in heat exchangers, condensers and evaporators. The 70-30 alloy is widely used for tubes, tube sheets and baffles in main condensers for fast turbine-operated naval vessels and ocean liners. The 90-10 alloy is used in ships' auxiliary condensers. The petroleum industry uses 70-30 for heat exchangers handling process liquors, vapors, and corrosive cooling water at temperatures too high for the usual brasses. The 90-10 alloy is for similar service in handling sulfur-free liquids where brackish water is the coolant. Copper-nickel castings are also used in fittings, wedges, seat rings, glands, turbine seal rings, bushings, valve bodies, impellers, disks, stems, pumps and compressors.

Copper nickels containing up to 30% nickel have a machinability rating of 20 (free-cutting brass is 100), same as that of copper. Tools, coolants and speeds used in machining the nonleaded coppers are OK for machining the copper nickels.

In inert-gas-shielded tungsten-arc or inert-gas-shielded metal-arc welding processes, the shielding gas can be helium or argon. Filler metal can be Inco's No. 67 (70-30 copper nickel) or Inco's No. 60 (Monel) wire. Flux-coated electrode metal-arc process can also be used. Copper nickels can be welded by resistance processes. Since oxides of these alloys are refractory, the surfaces must be cleaned before welding. Gas-welding procedures for welding copper nickels and Monel nickel-copper alloys are very similar, simplifying the job.

Ni-Vee (Inco trademark) bronzes are a family of copper-base alloys containing 5% nickel, 5% tin, some lead and zinc. Corrosion and wear resistance are high. Heat resistance is same as that of bronzes, up to 450 F. Prolonged exposure at such temperatures is permissible. In the as-cast condition, Ni-Vee bronzes are stronger and tougher than comparable G bronzes, red brasses and leaded bearing bronzes. Their tensile strength, as cast, ranges from

50,000 psi for type A to 25,000 psi for type E. Ni-Vee bronzes also offer good pressure tightness, soundness in light and heavy sections and excellent castability. Leaded Ni-Vee bronzes for bearings give more resistance to galling and seizure, even at high temperatures.

Ni-Vee bronzes are used in turbine runners, buckets, valve seats, disks, nonmagnetic switchgear, pumps, seals, valve and pump bodies. Their industrial classifications: (1) high-strength *constructional* castings (2) easy-to-cast *pressure-resistant* castings (3) improved leaded alloys for *bearings*.

Type A (0% lead) and type B (1% lead) are main constructional bronzes. Ni-Vee A bronze is good for driving gears when heat treated to a yield strength above 50,000 psi, tensile strength above 80,000 psi. Ni-Vee B castings are used for rollers and run-out tables on rolling mills, where they've delivered exceptional service.

Because lead in small amounts seals microscopic intergranular leakage channels, Ni-Vee type C (5% lead) is used where castings must resist fluid pressure from liquids or gases in valves, fittings, boiler accessories and hydraulic mechanisms.

Ni-Vee D bronze (10% lead) provides good resistance to bearing seizure. For large bearings subject to distortion from heavy loads, Ni-Vee E bronze (20% lead) gives resistance to seizure and galling.

In the as-cast condition, the Ni-Vee bronzes machine at about same rates as the corresponding G bronze, red brass, or bearing types they resemble. When some strength or hardness can be sacrificed, increasing the lead content improves machinability.

When heat treated, these alloys are harder and stronger, machine less easily than their as-cast counterparts. Therefore, where machining costs are high it's wise to heat treat these castings after most machining has been done. Here castings are annealed and quenched before machining, then temper heat treated to a higher hardness level.

Ni-Vee type A can be oxyacetylene-gas, carbon-arc- and metallic-arc welded. For good results, weld quickly. Use dc electrodes for metallic-arc welding with reversed polarity. For welding with carbon arc, a large, long arc prevents filler metal and molten-base alloy from dissolving gases. They would become porous from exposure to oxygen of the air and carbon monoxide. Ni-Vee is available in castings and is also supplied as rods by the continuous-casting process.

Cast Ni-Bral. Ni-Bral is Inco's trademark for a family of special 5% nickel-aluminum bronzes with adjusted alloy contents. In the as-cast condition, tensile strength is high and is improved by heat treatments. The Ni-Brals have good resistance to corrosion, erosion, and cavitation. They also have good fatigue resistance, high hardness and a low coefficient of friction. They resist impact down to −320 F and heat up to 750 F, are nonmagnetic and can be depth hardened.

Because Ni-Brals keep much of their strength at high temperatures and show good resistance to corrosion and oxidation, they are used for valves, fittings, electrical switchgear, impellers, turbine runners, pump parts, turbine rotors and stators, many other important services.

High-speed steel and carbide cutting tools are used for machining Ni-Bral. Cutting fluid coolants and tools are those used for mild steels. Some lead added to Ni-Bral improves the free-cutting qualities. But this may harm toughness, hot strength and weldability.

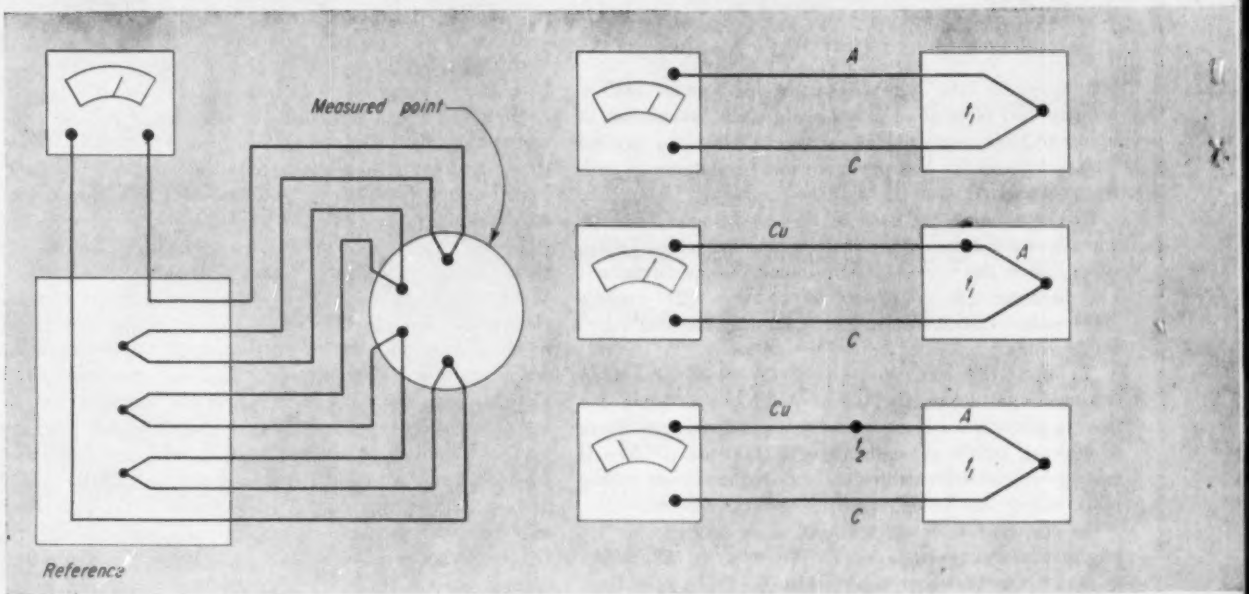
Ni-Bral is produced in castings only. It can be welded with shielded arc and a 200-F interpass temperature. Welds are often made with ordinary aluminum bronze electrodes. But stronger welds can be made with rods of composition similar to base castings. However these welds are less ductile. Welding Ni-Bral propellers using aluminum-bronze filler wire (inert-gas shielded metal-arc process) has these advantages: (a) You can weld in various positions. Metal-arc welding with covered electrodes is limited to flat position only. (b) Little or no preheat is needed. Manual metal-arc welding with aluminum-bronze electrodes needs up to 800-F preheating. (c) Deposited weld metal is a good color match for the casting. (d) Without changing equipment or filler wire, this procedure is OK for weld repairing manganese bronze castings.

Nickel silver comprises a family of alloys composed of copper, nickel, and zinc. Usually nickel silvers contain 45 to 72% copper, 10 to 30% nickel; balance is zinc. At least 25 nickel-silver compositions are available with tensile strengths of 30,000 to 45,000 psi. Higher strength can be developed up to and beyond 90,000 psi. Nickel silvers retain their ductility at low temperatures. Strength and stiffness increase with falling temperatures. Nickel silvers are used down to −300 F. They have good resistance to corrosion in rural and marine atmospheres, fresh and salt waters. Some special nickel silvers can be hardened by heat treatment. Annealing heat treatments are used to soften the metal for additional working or to relieve stresses, depending on quality needed.

Applications of nickel silvers are based largely on two qualities: color and corrosion resistance. Their resistance to salt water fits them for use as marine deck fittings. They are used as bathroom fixtures, flush-valves, food-equipment parts, hinges, ornamental pieces (grilles, hand rails) plumbing fixtures, and valve parts.

Most milling cutters and high-speed steel cut-off tools are OK for machining nickel silvers. Standard carbon or high-speed steel drills can also be used. Specially designed drills having more twists per in. than standard drills are often used for long-run operations. To get fine surfaces at high cutting rates, use a coolant. Although turning and drilling can be done dry in small operations, always use coolants on taps, dies, reamers, form tools, and cut-off tools. For nonleaded nickel silvers, use coolants of sulfur-free soluble oils in diluted water mixtures or mineral-lard oil compounds. Avoid sulfurized coolants; they discolor nickel silvers.

Nickel silvers are available as castings. In the wrought condition, nickel silver (10% and 18% nickel) comes as sheet, strip, plates, wire, rods, bar, tubes. Leaded nickel silver (10% nickel) comes as castings. Its other forms are: rod, bar extruded shapes and forgings.



THERMOPILE MEASUREMENT of very low temperatures solves low emf problem by multiplying signal with several thermocouples

THERMAL GRADIENTS must be avoided in the region of any junction between thermocouple alloy and lead wire to instrument

Do you operate refrigeration or cryogenic systems?
Power's series on performance testing shows you . . .

How to handle the problem of measuring low temperature

By LAWSON STEWART, Associate Editor

In POWER's October Plant Design issue we described some of the problems that go along with operation of cryogenic equipment. Now, we will go into one special area of operation: measurement of very low temperatures for performance checks on these systems.

Temperature measurements at levels below 0 F are difficult because of low emf's available from conventional thermocouples and low gas pressures or expansion coefficients for bulb or liquid thermometers. Also, some of the side effects which do not amount to much at the higher temperature levels become significant in the cryogenic region. Immersion corrections for glass thermometers are a function of the temperature differential between ambient temperature and measured temperature. Ground currents and possible errors due to lead-wire junction temperature also affect low readings.

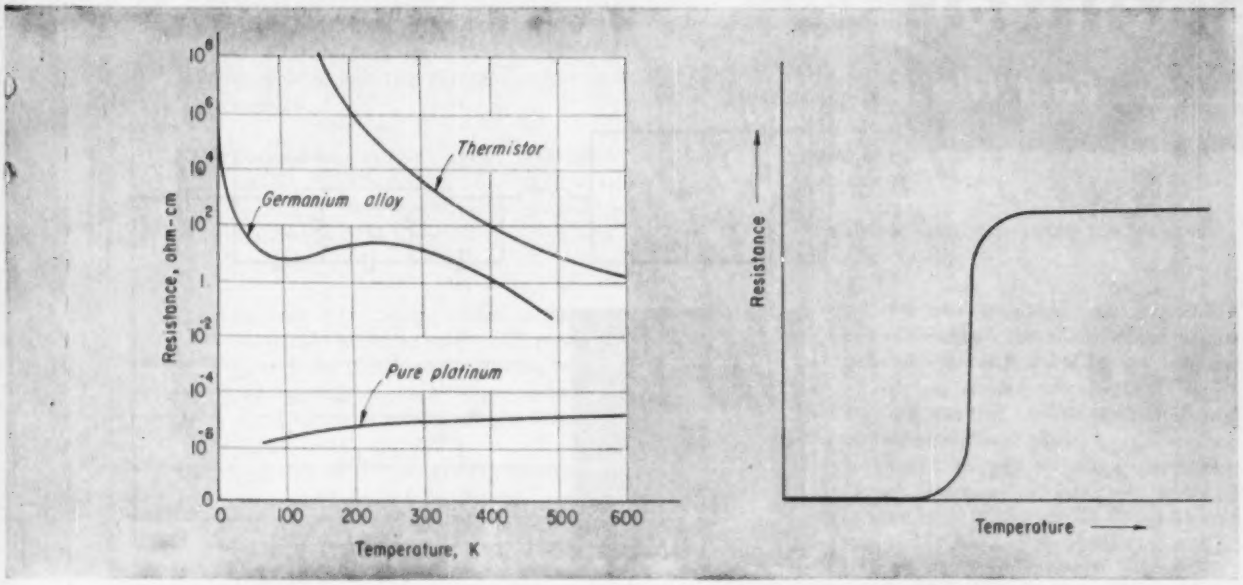
Liquid-in-glass thermometers intended for use at low temperatures usually are filled with organic liquids and have characteristics quite different from those of mercury thermometers. Drainage of liquid within the stem becomes very important. A reading taken immediately after immersion may be low by several degrees due to slow drainage of liquid from capillary walls.

Drainage can be speeded by first immersing only the bulb, leaving the stem warm, and then after a few minutes completing immersion. When the capillary is cold, drainage is slow because of higher viscosity of liquid.

Partial immersion of the liquid column creates another source of error. If it is impractical to immerse column completely, temperatures may be corrected by:

$$\text{Correction} = k\,n\,(T - t)$$

Where k is coefficient of differential expansion, n is number of degrees of stem emergent, T is temperature of the bath and t is mean temperature of emergent stem.



RESISTANCE THERMOMETRY offers good reproducibility of readings. Semiconductors supply greater sensitivity in their range

SUPERCONDUCTOR THERMOMETER gives high sensitivity in a small range by using element in its transition temperature area

Evaporation of volatile liquid used in the thermometer may cause additional error. Liquid which condenses on the side of the capillary can be seen, but any liquid which condenses in the expansion bulb at the top may be missed. Liquids used for this service include toluene, impure pentane and propane. Mercury freezes at −40 C. But the range can be extended to about −55 C by using the eutectic mixture of mercury and thallium.

Accuracy of liquid-in-glass thermometers is quite good in the low temperature range. Organic liquids are considered accurate to ± 1 or 2 C. Test quality mercury or other liquid metal thermometers are good to ± 0.2 C. Mercury-thallium thermometers to ± 0.01 C.

Thermocouples have several limitations for low-temperature work: low emf output and errors due to nonhomogeneous alloys in the leads. Both of these limitations are countered by the use of multiple thermocouples connected together as shown above, left. Multijunction thermocouples, or thermopiles, with $2n$ elements will produce n times the emf of a single couple.

Spurious emf's due to inhomogeneities in the leads of elements are just as likely to cancel each other as to add. So, the probable resultant error from this cause is only $\sqrt{n}$ times as large as a single couple.

Thermopiles can give excellent results when used to measure temperature differences. In this application the reference point becomes the second temperature monitored. Such an arrangement can reliably indicate temperature differences of 0.01 degree.

Thermocouple errors often result from emf's produced at lead-wire junctions, or where inhomogeneities exist. If there is a temperature gradient in the region around junctions, etc, emf generated introduces added error.

Three cases, shown above left, illustrate our problem. The upper thermocouple carries alloys back to the measuring instrument. (In this case assume self-compensating instruments.) Since the measuring junction is the only junction no spurious emf's are generated. In the second case, lead-wire alloy changes within the area of constant temperature. So, no error is introduced. In the third case lead-wire alloy changes out of the constant temperature area. Because of the temperature differential between the two points, the resultant reading will be in error by the amount of emf produced.

Resistance thermometry represents stabilized and reproducible readings of low temperatures. Spurious emf signals are not a problem, and several elements and alloys are available for low-temperature work.

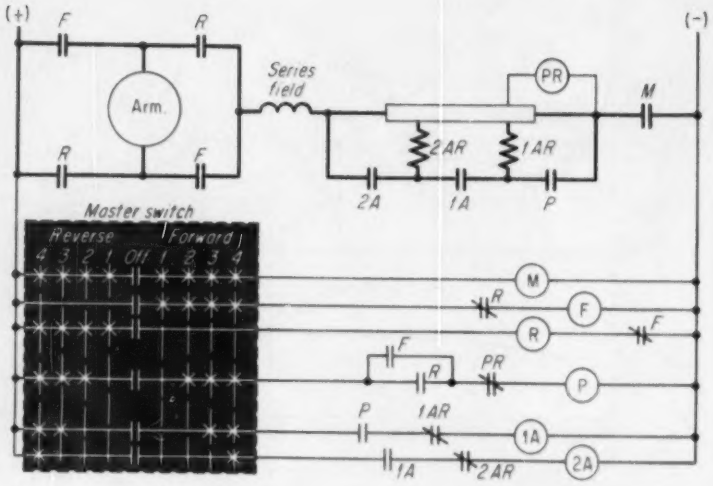
Resistance-temperature curves, above, indicate resistance for pure platinum. Although some alloys can be used for resistance thermometry, researchers found that small impurities increase resistance by an amount that is almost independent of temperature.

Semiconductors offer big advantages in thermometry because of their greater change in resistance per degree change in temperature. Thermistor and germanium curves indicate areas of use. Below 20 K carbon radio resistors can be used with good accuracy. Carbon is limited by less stability over temperature range than germanium alloy plotted above.

Tomorrow's thermometer may operate as above, left. Curve shows resistance of superconductor. Measurements in transition area would be quite sensitive to slight changes in temperature of superconductor.

Plant Electrical Fact File

No. 52: CONTROL DESIGNATIONS



Control-circuit drawings, like example right, usually use designations adopted by NEMA (National Electrical Manufacturers Association) to give device functions. Suitable prefix numbers or suffix letters may be added. A selection of frequently used function designations is given in these pages. For complete list see NEMA publication No. IC 1-1959

Control-circuit shorthand got you puzzled?

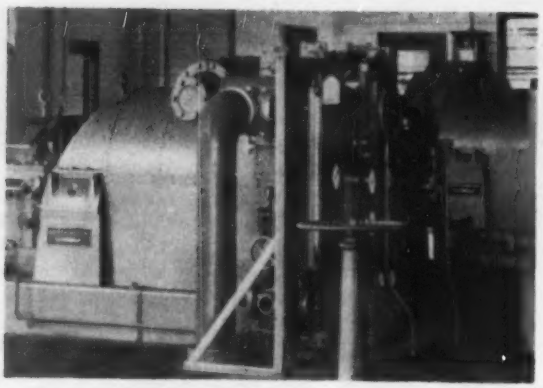
By NORMAN PEACH, Associate Editor

Designation	Function and definition
A	ACCELERATING AND DECELERATING CIRCUIT BREAKER, CONTACTOR OR RELAY initiates or causes the initiation of circuit conditions for bringing a machine up to speed or shutting it down.
AS	ARMATURE SHUNT CONTACTOR opens and closes a shunt circuit around a machine armature.
B	BRAKE CONTACTOR OR RELAY initiates the operation of an electrically operated brake.
BC	BALANCED CURRENT RELAY operates on the difference in current input or output of two circuits.
BV	BALANCED VOLTAGE RELAY operates on a difference in voltage between two circuits.
CR	CONTROL RELAY is an auxiliary relay which functions to initiate or to permit the next desired operation in a control sequence.
D	DOWN CONTACTOR OR RELAY initiates or causes the initiation of circuit conditions to operate a machine to give mechanical motion in the "down" direction.
DB	DYNAMIC BRAKING CONTACTOR OR RELAY initiates or causes the initiation of circuit conditions to stop a machine by dynamic braking.
DE	DECELERATING CONTACTOR OR RELAY initiates or causes the initiation of circuit conditions to stop a machine by regenerative braking or by some other method exclusive of dynamic braking, plugging and normal coasting stop.
DIC	DIFFERENTIAL CURRENT RELAY is a fault-detecting relay which functions on a differential current of a given percentage or amount.
F	FORWARD CONTACTOR OR RELAY initiates or causes the initiation of circuit conditions to operate a machine to give mechanical motion in the forward direction.
FA	FIELD ACCELERATING CONTACTOR OR RELAY forces a direct-current-machine field to accelerate a machine up to speed, in some cases as a function of certain limits of line current.

Designation	Function and definition
FL	FIELD-LOSS CONTACTOR OR RELAY functions at a given machine field current for the purpose of detecting presence or loss of field current.
GP	GROUND-PROTECTIVE RELAY functions on failure of the insulation of a machine, transformer or other apparatus to ground or on flashover of a direct-current machine to ground.
IS	INCOMPLETE SEQUENCE RELAY returns the equipment to the normal or off position and locks it out if the normal starting, operating or stopping sequence is not properly completed within a predetermined time.
ISW	ISOLATING CIRCUIT-BREAKER CONTACTOR OR SWITCH disconnects one circuit from another for purposes of emergency operation, maintenance or test.
J	JOG CONTACTOR OR RELAY initiates or causes the initiation of circuits to permit intermittent acceleration or jogging of a machine at low speeds for mechanical positioning of the machine or the material being processed.
L	LOWERING OR LEFT CONTACTOR OR RELAY initiates or causes the initiation of circuit conditions to operate a machine to give mechanical motion in the lowering direction or in the left direction.
LO	LOCK-OUT RELAY OR DEVICE is an electrically-operated hand-reset or electrically-reset relay or device which functions to shut down and hold an equipment out of service on the occurrence of abnormal conditions.
LS	LIMIT SWITCH detects a travel limit or any intermediate travel position for any form or adaptation of mechanical motion. This designation is usually expressed with variations as follows:
LSF	LIMIT SWITCH FORWARD
LSR	LIMIT SWITCH REVERSE
LSU	LIMIT SWITCH UP
LSD	LIMIT SWITCH DOWN
M	MAIN-LINE CONTACTOR connects a machine or power circuit to its source of running or operating voltage.
OC	OVERCURRENT RELAY functions when the current in a circuit exceeds a given value.
OL	OVERLOAD RELAY functions when the load of a machine or apparatus becomes excessive.
OPR	OPEN-PHASE REVERSE-PHASE RELAY functions when one phase of a polyphase circuit opens or when the phase sequence of a polyphase circuit reverses.
OS	OVERSPEED DEVICE functions at a given machine overspeed.
P	PLUGGING CONTACTOR OR RELAY initiates or causes the initiation of circuits to stop or stop-reverse a machine by plugging.
R	REVERSE CONTACTOR OR RELAY initiates or causes the initiation of circuit conditions to operate a machine in the "reverse" direction.
S	STARTING CONTACTOR, CIRCUIT BREAKER OR SWITCH initiates or causes the initiation of circuit conditions to connect a machine to its source of starting voltage.
SR	SERIES CIRCUIT BREAKER, CONTACTOR OR SWITCH connects two circuits or machines in series.
STP	STOPPING RELAY opens a circuit breaker or contactor or takes an equipment out of operation.
TR	TIME-DELAY RELAY provides a time delay between operations in an automatic sequence.
TSW	TRANSFER (OR SELECTOR) SWITCH is a manually operated device which transfers the control or power circuits to modify the plan of operation of the switching equipment or of some of the devices.
U	UP CONTACTOR OR RELAY initiates or causes the initiation of circuit conditions to operate a machine to give mechanical motion in the "up" direction.
UC	UNDERCURRENT (UNDERPOWER) RELAY functions at a given minimum current (underpower).
US	UNDERSPEED RELAY functions when the machine speed falls below a desired value.
UV	UNDERVOLTAGE RELAY functions on a reduction or failure of direct-current voltage or single-phase alternating-current voltage.
VLV	ELECTRICALLY-OPERATED VALVE is a solenoid or motor-operated valve in vacuum, air, oil or water line, etc, or one used for braking purposes.

These **plant problems** could well be yours...

Problem . . . Why does our turbine hunt?

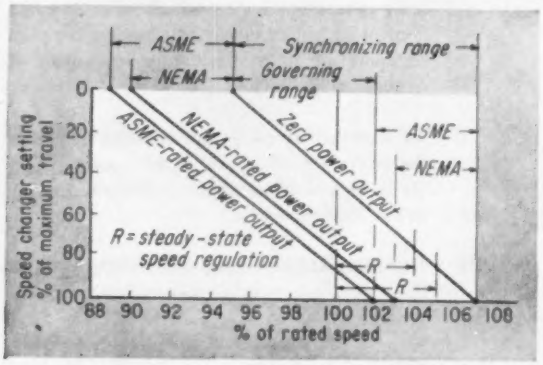


We have a 10,000-kw noncondensing extraction turbine-generator in our power plant. Throttle conditions are 450 psig and 600 F. Turbine exhausts to process line at 15 psig. Extraction steam flows to two large shell-and-tube heaters at 130 psig. Total extraction flow runs about 30,000 lb per hr.

Our problem appears to be poor load control of the turbine. With exhaust-steam demand held constant and product-heating requirements constant at the two heaters, turbine throttle flow is erratic. Hunting increases in magnitude if we cut generator load.

We've checked with the turbine manufacturer, but they could find nothing wrong with the throttle controls. Now we would like to hear from any readers who could suggest ways of tackling the problem.—*WSB, July* POWER

Solutions . . .



Test governor regulation

WSB does not mention turbine speed and type of governing systems used for extraction flow and speed control. Direct-acting mechanical linkage, hydraulic pressure or a combination of both are usually employed for this type and size of turbine. Each design has lagging characteristics resulting from inertia of the components of the governing systems. With a high-speed unit, lag should be at a minimum—necessary because rotational inertia of the rotor is so small that speed changes are very rapid. This is especially true for extraction turbines with small rotors and large flow.

A turbine designed for power generation and process-steam service should have speed regulation of 2 to 4% for power stability and extraction-steam pressure regulation not exceeding 10%.

When turbine has constant-speed (isochronous) governing it is not possible to keep stable control throughout the entire load range. A tolerance of 1% steady-state regulation is usually allowed.

Many turbine governing systems have speed changers. These permit manual or automatic speed changing as may be required after a load change. With proper governor regulation at all settings of the speed changer, hunting is minimized. Plot above showing these relations is taken from ASME *Power Test Code* PTC 20.1-1958.

I suggest *WSB* adopt the following procedures to eliminate present problems:

(1) If a mechanical governing system is installed, inspect for wear of all parts. Excessive play of linkage components will cause too much lag.

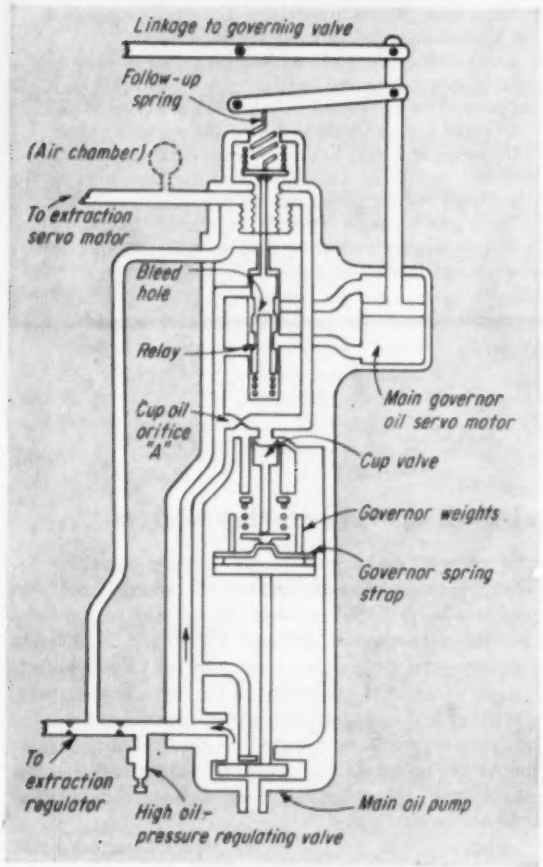
(2) If a hydraulic system is used, take temperature of

...Here's how Power readers would tackle them

LAWSON STEWART, Associate Editor

oil entering and leaving coolers and compare with values recommended by the turbine manufacturer. High temperature and low viscosity will cause governor response lag. Insufficient cooling-water flow, dirty oil coolers, plugged piping and tubing and partly closed valves are frequent causes.

H B WAYNE, *Woodhaven, N. Y.*



Check oil-governor internals

There are a number of conditions that can cause hunting in the governor of *WBS*'s turbine. If his turbine is equipped with an oil-transformer governor similar to the sketch, the following points can be checked:

(1) Determine if main oil pressure is constant. Fluctuating main oil pressure can be caused by a defective high-oil-pressure relief valve, or excessive clearances in oil-pump gears.

(2) If oil in reservoir shows foaming, check with turbine-oil supplier to determine if antifoam agent can be added to reduce foaming.

(3) Inspect oil in reservoir, while operating turbine, for entrained air in oil. Air bubbles can be trapped in some parts of the governor, such as high spots in bellows piping, forming a cushioning effect which causes hunting. Trouble of this type was corrected in one of our turbines by drilling a .040-in.-diameter bleed hole in the hollow governor relay to release trapped air to a drain-oil chamber. Extra flow of oil through the bleed hole was compensated for by enlarging cup's oil orifice.

(4) Inspect orifice bleed holes in bellows. Remove plugs from bellows and flush interior with solvent to remove any dirt particles which may move around in the bellows and plug the orifices.

(5) Try operating turbine with oil temperature higher or lower than normal and see if hunting is reduced.

(6) Although entrained air caused trouble in one governor, hunting condition in another was corrected by use of a small air chamber on piping which connects main governor bellows to the extraction servomotor (shown in broken lines on drawing).

(7) Check spring strap on which governor weights are mounted. Although this strap may be free of cracks or apparent defects, it may have a buckling or snapping characteristic when governor speed is changed slightly by turbine load changes. As the total governing movement of the cup valve is a few thousandths of an inch, a small abnormality in the operation of this spring can cause hunting. Hunting may be more intensive at certain load conditions.

Before drilling bleed holes or making adjustments not covered by the turbine instruction book, it may be advisable to consult turbine-factory engineering department to avoid oversizing bleeds.

C TRETINYAK, *Rochester, Minn.*

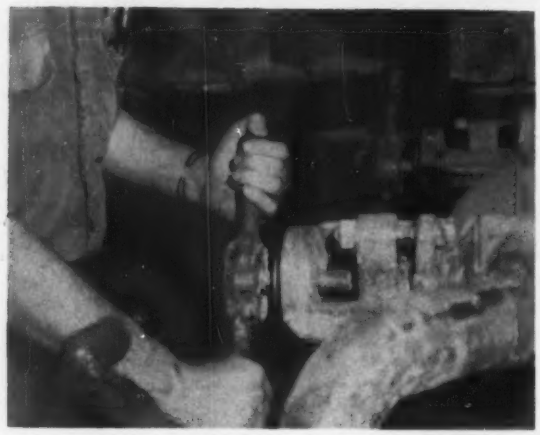
Heater level can cause hunting

Extraction steam flows may vary with changing water level in the heat exchanger. Check drain and vent system closely. An irratic level would help explain why hunting increases at reduced turbine loads. If level changed enough to permit steam entrainment in the heater drain, situation would be even more erratic. Improper drain control-valve action or incorrect sizing of the valves could result in valve hunt and turbine upsets.

M L MYERS, *Concord, Tenn.*

Want some help on plant problems? Send us any of your design or operating headaches for Power reader comment

Problem . . . How can we speed steam-line warmup?

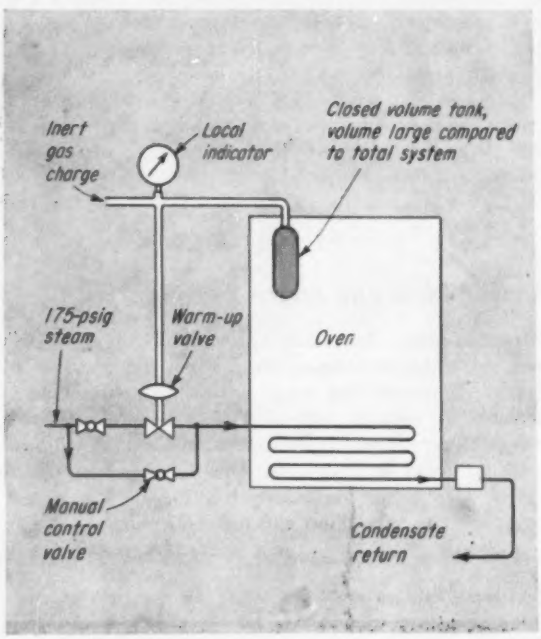


Our process-heating load is supplied by 175-psig steam. Two 50,000-lb-per-hr boilers generate the steam which is carried to three process buildings and several surrounding buildings. Each of these outer buildings contains several steam-heated curing ovens. Ovens are loaded periodically, with up to a week between charges for one oven. Steam temperature is actually controlled by a pressure-reducing valve for each oven.

Our problem is one of man-hours involved in warmup of cold steam lines and heating coils. Each unit must be warmed up slowly and requires the attention of one man about five or six times during the warmup period. This becomes a real headache when several ovens in different buildings are ready for warmup simultaneously. Then we need extra operators.

We'd like to know whether any reader has found a way to handle warmup programs automatically, or some faster manual means?—*JFB, July* POWER

Solutions . . .



Let oven operate startup system

Since present operator coverage appears adequate for manual steam-temperature control, it is suggested that equipment be provided to cover the warmup period only. A possible arrangement, although not proved, is to install an air-operated diaphragm-motor control valve which is actuated by an inert gas heated in the oven. For temperatures up to 400 F, initial pressure will just about double. The operation could be initiated by an orificed bypass or globe valve and would thereafter proceed through a warmup cycle until the valve was opened. Normal regulation would not be changed.

M L Myers, *Concord, Tenn.*

Keep steam lines hot

I would suggest installing a takeoff from the steam headers at the boilers with a pressure-reducing valve set for five or ten psig. This line could be one or 1½ in. depending on requirements, and would admit l-p steam to the main line to keep it heated at all times. Main line could be trapped and the condensate returned to the boiler room.

This would be less expensive than the existing setup, and in fact could lead to savings in main-line maintenance which undoubtedly results from existing on-off type of operation, and its resultant stretch and shrink of the main supply lines.

Economics of the problem comes into play and depends on *JFB*'s geographical location, cold or warm climate, type of lines he has to heat—in a trench or above ground, insulated or uninsulated—existing labor costs, heat losses with the proposed system, etc.

R A Rousseau, *New Bedford, Mass.*

Use time-temperature controller

To make this operation automatic it is possible to purchase time-temperature controllers similar to those used to control cooking in pulp- and paper-mill digesters. Controller uses a clock-driven cam to actuate the control valve, opening it on a predetermined time cycle to raise pressure or temperature in the digester. Cam can be cut in the field to give any desired rate of pressure increase. Different cams can handle varying warmup schedules.

To speed up the operation, place control valve right next to oven and trap the lines just before the valve. This will keep supply lines hot at all times so that they will not have to be warmed each time the oven is started up.

J L Aikman, *Westmount, Quebec, Canada*

Bleed steam to ovens continuously to cut pipe stress

Don't let the steam lines get cold—keep them warm. The critical interval in warming up steam lines is during the period from really cold to warm, when the greatest expansion takes place quickly and puts many strains and stresses on the pipe and its supports. From warm to hot is much less critical; therefore, the practical thing to do would be to keep the lines warm.

This may be accomplished by installing a bypass and valve (normally closed) around the pressure-reducing valve at each oven, the valve to be partially open except when oven is actually in use. This will not only reduce the warmup period but will prolong the life of the piping by cutting down on thermal stresses causing fatigue in piping, hence lowering maintenance.

The cost of steam used while shut down will be more than compensated for by shortened warmup period and lowered maintenance costs.

W E Brumby, *Levittown, Pa.*

Your November problems

How can we improve maintenance and operation record for new heater?

We plan to install a new water heater for the mine change-house water supply shortly, and have hopes of making some improvements meanwhile.

Our original installation had the regulator two-thirds of the way from the bottom of the hot-water storage tank. We have been told that moving our regulator to the midpoint may supply more hot water.

Because regulator-bulb failure meant a shutdown to replace it in the shell, we would like to weld a well in place in the new tank to permit exchange of bulbs.

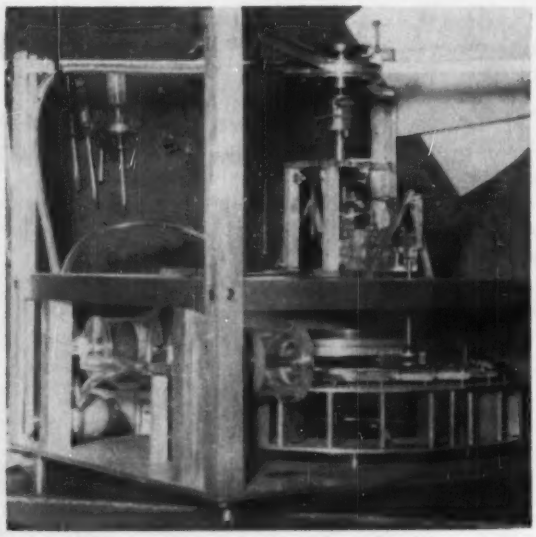
Our problem is first one of getting the best control and highest capacity from our heater. To help us decide we would like to hear from Power readers on the effect of regulator level on capacity and control. Also, we would like to know if using a temperature well would make the regulator's bulb too insensitive. —*MMK*

Can we stop fines blowing away?

Our coal pile contains 43,000 tons of bituminous aggregate of which 50% is fines and about 50% of 2½ in. The coal is oil-treated at the mines. Our problem—coal falls from a conveyor boom for a distance of eight to 12 feet, and fines are carried away on windy days. Dust is a nuisance to nearby offices and homes and of course there is waste. We cannot water down the pile as coal cannot contain more than 8% moisture. Can Power readers solve this problem?—*EJ*

Sit down right now and answer one or both problems. We'll pay extra for answers with photos or sketches

Timely **practical ideas** to help solve



This training aid gets idea over quickly

Many large utilities realize the importance of a training program to educate their operators in understanding costly machinery. Thousands of dollars can be saved by eliminating operating "boners." This is especially true in the electrical power industry.

Perhaps there is no more effective aid in training than the working scale model. Many of these aids have been developed by workmen who have a talent and skill for constructing apparatus in miniature. Most companies are quite liberal in compensating employees who come up with some idea that makes for better operation like this working model. Such ideas go one better than the old Chinese saying that, "one picture is worth a thousand words." A working model can often allow the observer to look into the "innards" of machinery and see exactly how it functions and how a sequence of operations develops.

Our model, photo, is an exposed water turbine without its scroll case. Its purpose is to demonstrate how the governor, servomotors and wicket gates on a turbine work, thus taking care of speed and load changes. Turbine is almost entirely of aluminum with the exception of the governor casing, servomotor cylinders, and the water lines which are made from transparent plastics. This miniature is complete in almost every detail and most practical.

For demonstration purposes the model is driven by a variable speed motor. Brake at the top of the unit is used to simulate actual speed and load changes.

We believe that a fifteen-minute session with a model of this kind will give an operator a better insight into the governor's function than many hours with reading matter and sketches.

W BUCKSHEE, *Shawinigan S, Que.*

Use a nut

At times we have to shorten a small bolt. To restore the threads when right-size die isn't available, the nut is left on so it can be turned off after the bolt is cut. You can make a nut specially for this purpose by fluting or filing out grooves as in a die nut. Threads can also be repaired in nuts by fluting the bolts so the bolt can be used as a tap. We have repaired female threads in emergencies at different times by this method when we didn't have the right-size tap or die.

M L MONSOR, *Fosston, Minn.*

My biggest boner

I was an assistant unit operator on a 125-mw turbine-generator and a million-lb-per-hour pulverized-fuel-fired boiler. Unit had two forced draft and two ID fans. We were making various tests in this new plant. Load had just been dropped to 20 mw. It was to come back to full load at rate of three mw per min for test purposes. Picking up load this fast by increasing boiler steaming was new to unit operator and myself.

Before, we had always reached a fairly level state before placing controls in the automatic-control position. At times we had trouble before forced-draft equipment would level out and hold proper air flow on automatic. To compensate for this, instrument mechanics had installed bias-adjustment control valves on control board. This let us zero the automatic impulse or position it anywhere below its pneumatic auto-loading pressure for any of the fan-damper-control subpanels. This helped the fans on automatic as I had only to open up the fuel-air ratio. While the FDs were on "hand" and as the automatic loading for the fans increased, I could bias the loading back to any desired valve or to the manual-loading valve. Then place fans on automatic and work the bias out at a later time.

Unit operator agreed to my idea of placing fans' offset in "auto" position and zeroing the loading with the bias knob. This would allow me to slowly open the bias valve after the fans were started. Then air flow would be on automatic while we came to full load.

I placed the running fans on "auto," then the offset to "auto." Nearing 60 mw, the unit operator cautioned me to start my second set of fans, adding, "better not try this automatic from the start; place the fans

your tricky design and maintenance problems

STEVE ELONKA, Associate Editor

back in manual position and take the bias out of automatic loading for now." Good advice.

I placed the ID-fan subpanel selector in "hand" position and started opening the bias adjustment to full-open position. Then I started my ID-fan motor and followed by starting the FD fan. Chaos abounded. The furnace-draft gage pegged on positive pressure. The one ID that was on "auto" opened wide but the furnace-draft safety regulator started cutting back the fuel. The shift engineer rushed out to check the furnace fires. Needless to say, the flames shot out from the furnace doors. Then I saw the FD fans I had just started were still in "auto" position. Since the bias valve was wide open, the auto impulse to the control damper was equal to the impulse for this steam-flow condition. The FD fan had started loaded while the ID had started with the damper closed and the control in "hand."

This ruined the test and the nerves of everyone concerned. You can bet that I'll always check the position of the control selectors before starting any machinery from now on. I may never be lucky enough to get by with this fool stunt again.

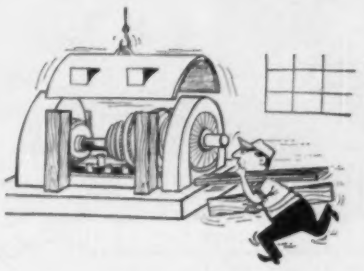
G W EMERY JR, *S Pittsburg, Tenn.*

No, don't do it

In June 1960, *Practical ideas*, p 252, L B Villarta asks if thin-babbitted bearings should be scraped. My answer is no, *never*. It's OK to remove shims or to file the bearing cap. In an extreme emergency, you can blue the shaft for high spots, then use a high-speed portable grinder and grind out the high blue spots. I know this is usually a scraping job but a careful mechanic can do it. No efficient mechanic ever scrapes a thin-babbitted bearing for modern machinery.

C G HOWARTER, *Canton, Ill.*

EDITOR'S NOTE: *I have never heard of babbitted bearings being ground instead of scraped. Seems to me the wheel would fill with babbitt immediately, or that tiny abrasive particles embedded in the babbitt would eventually score the shaft. Don't believe I'd try it. What do you maintenance guys say?* STEVE ELONKA



What would you have done?

It was time for a routine dismantle and inspection of one of our 3000-kw turbine-generators. Our bridge crane has 10-ton capacity. Drum and cable are electric-motor driven; trolley and bridge are hand operated with chains. The drum-hoist gears were cast iron mounted on steel shafts. Before starting the job, we gave crane a thorough inspection and lubrication.

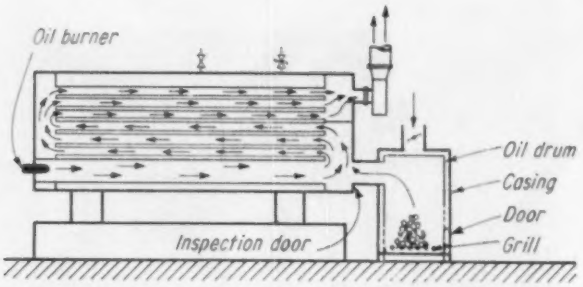
Work started on day shift. Night shift came on at 4 pm, had the job of removing turbine's top casing. At 7:15 pm the night man called me. Our hoist had stripped two gears and that 4½-ton casing was suspended over the turbine spindle, two inches short of clearing the 15th-stage wheel. He had placed heavy wooden blocks under the casing because he had no idea what kept the load suspended.

Arriving at the plant, I had 2x12-in. planks placed between blocks and casing, and some more blocks to take up a 2-in. gap. If hoist did give away, planks would keep blocks steady, preventing damage to turbine spindle. We inspected the hoist. Only thing keeping the load suspended was a jammed broken gear tooth. Wow!

Hoist couldn't be raised or lowered. We had to figure a way to pick up the load and remove it from the hoist so we could repair the crane. We located a 5-ton chain fall in good condition and two long ⅝-in. cable slings. Hoist drum was strong enough to support the load. We wrapped the cables around the drum and were able to hook the chain fall onto the casing slings. We took a strain on the chain fall and raised the load enough to clear the wheel.

Casing was moved over to a clear area. Then we raised the load to put enough slack in the hoist cable so we could remove the crane hook and lower the casing to the floor. Doing some close figuring, we got enough slack into the hoist cable so that we were able to remove the hook. Then all we had to do was lower the load with the chain fall and we would be safe. Every man gave a sigh of relief when the casing finally rested on blocks. We repaired the hoist, replacing the cast-iron gears with steel gears. It was ready before we reassembled the turbine. We learned one thing from that near-tragedy: don't put too much faith in cast-iron gears when lifting heavy loads. What would *you* have done?

J A FULLER, *Riverside, Calif.*



Home-made Dutch oven keeps plant running

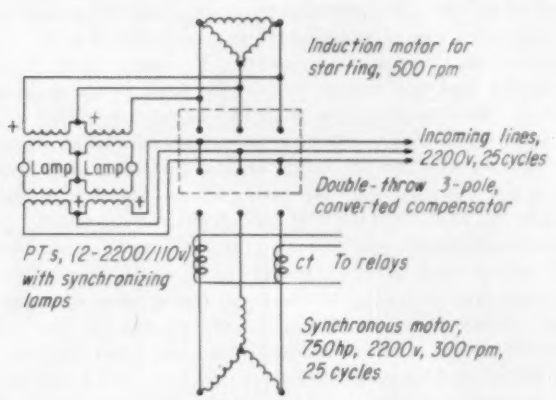
A food factory where I was supt ran short of fuel oil. Our boiler was a dry-back firetube type which supplied steam for our driers. The factory was on a dirt road, a hundred kilometers from the nearest fuel-oil supplier. When it rained continuously for a very long time the road became impassable for the heavy oil-tank truck and right now it *was* impassable. Shutting down that boiler meant heavy losses because food products would rot in a few hours.

Near our factory was a big coconut plantation where coconut shells could be had for the asking. My problem was to find a way to burn these shells.

I made a Dutch oven, sketch, from a 50-gal steel oil drum. We removed the bottom and replaced it with grillwork made of ⅝-in. round bar stock. Then we cut a charging door into the drum's side above the grillwork for feeding the coconut shells. After cutting a vent outlet for the hot gases near the top, we built a jacket around the drum with a few inches of air space between the double shells. Air intake was at top through a butterfly valve which controlled firing rate. Air needed for combustion would come in past this valve, cool the double casing while the burning coconuts would preheat the air. Then the hot air would come up through the grillwork and through the coconuts and up into the boiler tubes.

We still fired the boiler with oil while burning coconut shells, but used only about 70 percent oil. That pulled us through until oil could be delivered. We learned that coconut shells as fuel have three remarkable properties: (1) high heating value (2) smokeless combustion and (3) negligible ashes. This Dutch oven worked so well that we saved it for insurance in future emergencies.

P G KUIZON, *Quezon City, P. I.*



Here's how we got back into phase

My outfit had a small electrical contract for a stone-cutting firm. This firm had bought a lot of second-hand equipment from a fast-talking character, among which was a 750-hp 2200-volt 25-cycle synchronous motor with 10 poles, designed of course to run at 300 rpm. On one end of the shaft was the exciter for the synchronous motor. On the other end they had installed an induction motor for starting purposes. No-slip speed of the induction was 500 rpm—the "joker" in the haywire mess.

They had hooked up a starting compensator switch so that in the starting position the juice was applied to the induction motor—then throwing the switch to the "run" position applied juice to the synchronous motor. With the difference in speeds they had no hope of making the synchronous machine pull into step. It was just out of phase and the relays tripped at every trial.

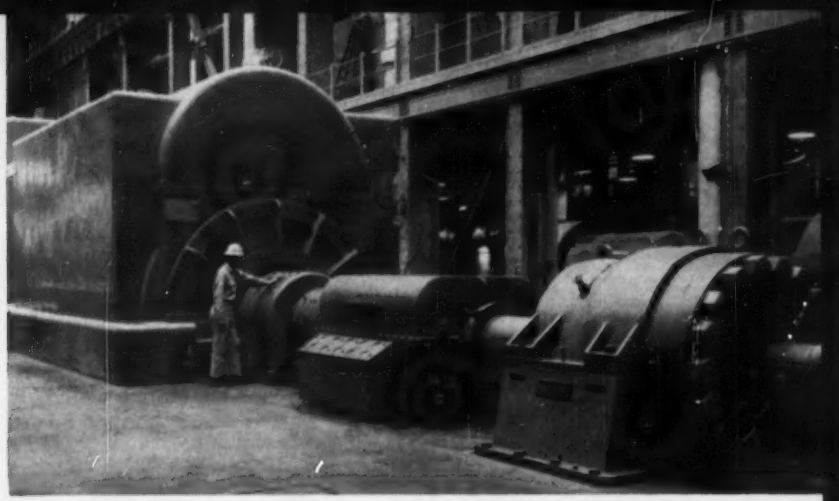
I was called to straighten things out. Of course, the first thing I wised up to was the speed difference. So when I explained, the guy who had bought the junk was naturally sore.

I suggested to him that by installing some small transformers to reduce the voltage, and by hooking some lamps in the secondary circuit, we could, by manipulation of the starter switch, synchronize the machine when the speed was at the correct value. I hooked the lamps up as shown in sketch and synchronized on my first shot.

The potential transformers are hooked up to take the place of a synchroscope used often in the past. PTs can be connected to give either bright or dark lamps to indicate in-phase conditions—as you may wish.

L MCWILLIAMS
Shawinigan Falls S, Que.

By W F UHLHORN
General Superintendent, Astoria Station, Consolidated Edison Company of New York



"ON-THE-SHAFT" DRIVE for boiler-feed pumps at Con Edison's Astoria Station was a first. Reliability level attained in 2-yr operation has led to additional orders

On-the-shaft pump drive rounds out 2nd yr

Anticipated cost savings of first generator-shaft hydraulic-coupling arrangement paid off. Fluid drives at Con Edison's Astoria Station met the acid test; only trouble involved accessories

In October 1958, Con Edison's new 335-mw unit went on the line at Astoria Station. World's largest generating unit at the time, it was also the first "on-the-shaft" boiler-feed pump drive arrangement—pump driven off the generator shaft through an American-Standard Gyrol Fluid Drive.

Original evaluation of several boiler-feed-pump drive arrangements showed full-capacity shaft drive with two half-capacity spares to cost at least $600,000 less than three conventional half-capacity pumps. Reliability level of this original drive arrangement now permits us to move one of the half-capacity spares to a subsequent unit, saving even more money. And further saving yet is available to us: we could eliminate the half-capacity spare altogether and substitute a small startup pump.

Hydraulic couplings specifically designed for on-the-shaft drive have features not normally needed for motor-driven boiler-feed pumps or fans (see POWER, Oct 1956, p 104, *Selecting the largest feed-pump drive*). Some of them:

(1) Special inboard thrust bearing, designed for 8000 lb, absorbs axial thrust produced by expansion of generator shaft.

(2) Height to center line of turbine-generator is fixed (about 30 in. above finished floor), so coupling must be side-supported. And to present a clean appearance, all pipe connections go on the bottom with accessory equipment — oil pumps, coolers, filters—on the floor below.

(3) A magnetic brake on the output shaft of the hydraulic coupling lets the boiler-feed pump stop for inspection without interrupting generator output. Otherwise, windage in the hydraulic coupling would keep the boiler-feed pump rolling indefinitely even when fully declutched. Interlocks based on both oil pressure and time prevent brake operation at output speeds above 1000 rpm. At higher speeds, energy for the brake to absorb would be beyond its rating. After the output shaft has stopped rotating, brake is locked mechanically and de-energized.

(4) Separate lube- and control-oil systems serve the hydraulic coupling at Astoria. But other systems—separate and integrated—are available to meet utility preferences.

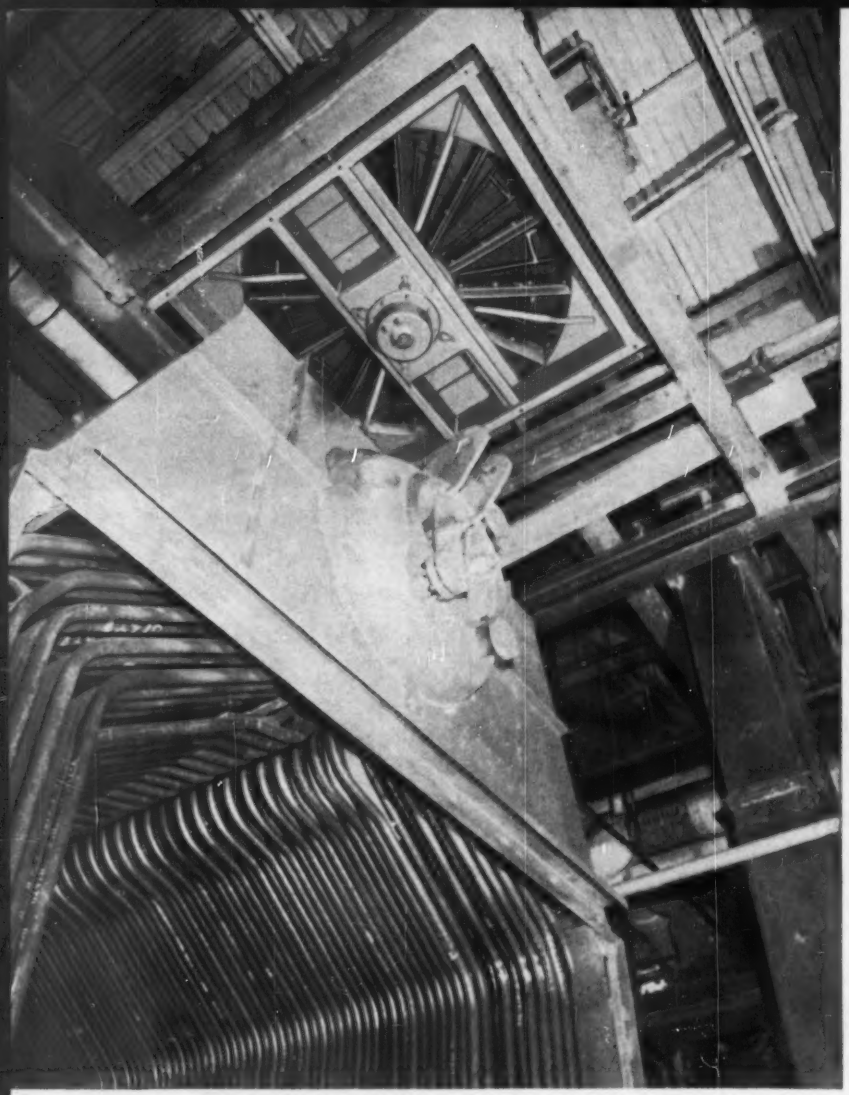
Our main-shaft hydraulic coupling, rated at 12,000 hp, 3600 rpm, has experienced no operating difficulties since startup. Minor difficulties with accessory equipment serving the coupling included control equipment for the two motor-driven lubricating-oil pumps and oil-cooler design. These problems and their solutions should guide future designs toward even higher degrees of reliability.

Two lube-oil pumps are rated 140-gpm each. Either will meet bearing's oil needs with the other as a spare. Initially, motor-overload protection was set too close. On a scheduled switchover one motor tripped—and the other had not been reset. Complete lube-oil failure resulted.

East River water used for oil cooling is notoriously poor, so duplex tubes were specified in all coolers. But coefficients of heat transfer were less than anticipated. Abnormally high cooling-water temperatures, coupled with heat load added by design features of the hydraulic coupling, made cooler size inadequate.

Both accessory problems were easily corrected and we've had trouble-free operation ever since. As a result of this service, four duplicate units are scheduled for startup within the next few years in the Con Edison system in addition to the two now running—our Astoria unit and a duplicate at Arthur Kill Station.

(Advertisement)



The Ljungstrom Air Preheater at the B. F. Goodrich Company Shelton Plant is installed directly over the 65,000 lb/hr Wickes boiler. Flue gas leaving the boiler at 615°F passes through the circular rotor, which absorbs the heat and releases it into the incoming air. Preheated combustion air improves combustion, makes fuel burn cleanly. This Package Air Preheater was factory-assembled, and requird only 100 manhours to install.

At B. F. Goodrich Co.'s Shelton Plant

Air Preheater boosts combustion air temperature 345°F... gives 6% more thermal efficiency

"Only a Ljungstrom® Air Preheater, with its continuous regenerative principle, could meet our requirements", says A. G. Sandomirsky, Manager of Engineering at the B. F. Goodrich Company, Shelton, Conn., plant. "We produce foam rubber 24 hours a day, five and six days a week. With an Air Preheater we can meet process steam requirements more economically, and an Air Preheater helped us to justify the installation of high efficiency, high pressure equipment for by-product power generation."

Here's why the Shelton plant meets its requirements best with a Ljungstrom Air Preheater:

1. Ljungstrom is the most efficient heat exchanger you can buy. The Ljungstrom rotor revolves continuously through the flue gas and incoming air, thus absorbing heat and releasing it *from the same surface*. Since the heat doesn't have to pass through anything, each inch of rotor surface is as efficient as one foot of a tubular recuperator.

2. Ljungstrom is the most reliable heat exchanger you can buy. All heat exchange elements pass through the entire air and gas streams. The temperature of the elements in the coolest region – where fresh air enters – is actually an average of the gas and air temperatures, so it's consistently higher than the coolest point in a recuperative heat exchanger. Result: no cold spots, less chance of moisture formation.

3. Ljungstrom is easiest to maintain. You can inspect it – and clean it–while it's running. Heat exchange elements are divided into modular baskets that can be replaced individually without disturbing the other elements. You can even reverse the elements if the surface has thinned on one edge, effectively doubling the life of the heat exchange surface.

For more information on the Ljungstrom continuous regenerative principle, or on the Air Preheater that meets your requirements, phone MUrray Hill 2-8250 or write to The Air Preheater Corporation.

THE AIR PREHEATER CORPORATION

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For more facts circle 349 on Reader Service card, p 103

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"By reason of special training, wide experience and tested ability, coupled with professional integrity, the consulting engineer brings to his client detached engineer and economic advice that rises above local limitations and encompasses the availability of all modern developments in the fields where he practices as an expert. His services, which do not replace but supplement and broaden those of regularly employed personnel, are justified on the ground that he saves his client more than he costs him."

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Los Angeles

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Electrical

Minimum 6 years experience in design of steam power plants or heavy industrial projects. Areas of work include power distribution design, equipment specifications, control circuit and control board design, instrumentation and automation. Supervisory experience and leadership ability desired. B.S. degree requird.

Mechanical

Minimum of 6 years experience in design of steam power plants or heavy industrial projects. Areas of work include power distribution design, equipment specifications and procurement, and instrumentation and automation. B.S. degree required.

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Must have experience in heavy industrial projects and have leadership ability. B.S.C.E. degree required.

Relocation allowances cover moving costs plus transportation reimbursement for you and members of your family. Send confidential resume, including present and required starting salary, to Technical Recruiting Division. Personal interviews will be arranged for qualified candidates.

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Corporation

5120 Soto Street

Vernon, California

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Control Valve Manufacturer requires mechanical engineer presently engaged or desiring position as inside Application Engineer. Prefer strong background in power plants. Permanent position. Suburban living. Limited travel. Salary commensurate with background and experience. Send résumé with salary requirements.

KIELEY & MUELLER, INC.
64 Genung Street, Middletown, New York

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Water Treatment firm desires agents east of Mississippi to sell Water Softeners, Filters, etc. Agents now calling on consultants, contractors and industrial accounts. Submit area covered and accounts handled.

RW-4927, POWER
Class. Adv. Div., P.O. Box 12, N.Y. 36, N.Y.

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Leading Water Treatment Company has several openings in key territories. Chemical background or power plant experience required. Reply in confidence. Box P 1519, 125 W 41 St., N. Y. 36, N. Y.

When Answering

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POSITIONS VACANT

Mechanical Engineers. Excellent opportunity for Project Managers, Project Engineers, and Design Section Chiefs experienced in design of heating, ventilating, air conditioning, piping, power plants. Extremely wide variety of work (including client contact) with established Midwest consulting firm. Permanent. Good starting salary, advancement and vacation program. Moving expenses paid. All replies will be answered. P-3214, Power.

Operating Engineer—Glenrock, Wyoming in the new 200,000 K.W. Dave Johnston Steam Plant. Will supervise Results Engineer, Chemist and related personnel and operate relief shift. Mechanical Engineer degree required plus operating, maintenance or construction experience. Excellent advancement opportunities in this aggressive, growing Pacific Northwest Utility. $685.00 to start, promotion on merit, plus excellent fringes. Expenses paid. Send resume to: Employment Manager, Pacific Power & Light Company, Public Service Building, Portland 4, Oregon.

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Power Plant Engineer, age 38, technical education, 8 yrs. experience as chief engr. in the operation, maintenance, management, and plant betterment. PW-3449, Power.

Qualified Engineer, twenty years experience, maintenance and operation, Power Station, Oil Refinery, Marine, twelve years South East Asia. Desires supervisory position in South East Asia. PW-5127, Power.

Canadian Power Plant Engineer Age 31. Senior Matriculation and technical education. Ten years varied experience in large central thermal power stations. Foreign employment also considered. PW-5365, Power.

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Engineering Sales office with forty years experience wants additional sales account of mechanical equipment in power field in Philadelphia area including southern New Jersey, Delaware and Maryland.

RA-5429, POWER
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WANTED

1—2500-5000 KW TURBINE GENERATOR 400#-600# throttle, 700-750°, with surface condenser, 3-60-4160 V., with switchgear if available.

Please quote us on any other turbine-generators, condensing on non-condensing, 1500 KW or up.

JOLIET EQUIPMENT CORP.

Gross Street **Joliet, Illinois**

SAratoga 6-1922

Circle 503 on Reader Service Card

COMPLETE MODERN 400 LB. POWER PLANT

3750 KVA Westinghouse Turbine Generator — 2 600 HP Combustion Engineering Boilers, 450 PSIG W. P. Turbine is 400 PSIG 750° FTT with surface condenser and auxiliaries. Generator 3/60 6900/4160 with Exciter and Switchboard. Surface Condenser and all auxiliaries.

This plant is complete in all respects and can be inspected as originally installed. Photographs, prints and specifications available

Other turbine Generators

1-2000 KW GE	600# 750° Non-Cond. 150# BP 4160V/6600V
2-3000 KW Westinghouse	600# 750° Non-Cond. 125/150# BP 2400V
1-2500 KW Allis Chalmers	400# Autext 150° Non-Cond. 30# 480V
1-2500 KW Westinghouse	125# Non-Cond. 10# BP 2300V
1-2500 KW GE	400# 750° Autext 25# Condensing 600V
1-5000 KW Westinghouse	850# 850° Non-Cond. 110# BP. 2400V
1-6000 KW G.E.	200# Condensing 2300V
1-7500 KW Allis-Chalmers	850# 850° Non-Cond. 110# BP.

Cable Address: CHASWEAVER

CHARLES WEAVER, INC.
19701 JAMES COUZENS HIGHWAY
DETROIT 35, MICHIGAN

Telephone: BRoadway 3-1900

CIRCLE 504 READER SERVICE CARD

FROM AIRCRAFT CARRIER "ENTERPRISE"

[4] 1000 KW GEARED TURBO-GENERATORS

For Condensing or Non-Condensing

1000 KW TURBO-GENERATOR COMPLETE WITH CONDENSERS CIRCULATING PUMPS CONDENSATE PUMPS AND SWITCH GEAR

GENERATOR: 1000 KW — type ATB-2 — G.E. — form H.L.—1250 KVA—3/60/450—1805 amps—3600 RPM—0.8 P.F.—field amps 87—typical serial No. 5358295—with 120 volt 11KW DC exciter—compound wound.

STEAM TURBINE: 1000 KW G.E.—type FSN-4R-FN30-85TG—rated 7984 RPM—exhaust 1 lb. absolute when condensing.

REDUCTION GEAR: S-11B—form A—RPM 7984/3000.

TURBINE STEAM PRESSURE: 575 lbs—175°F superheat-exhaust pressure 1 lb. absolute when condensing. Can be used condensing or non-condensing. Can be operated at reduced pressures.

BUILT AS MARINE UNITS USING FINEST MATERIALS. DRIP - PROOF CONSTRUCTION. UNITS ARE 16' LONG — 7'8½" WIDE. MOUNTED ON PRE-FAB SUB-BASE.

THE BOSTON METALS CO.

313 E. Baltimore St. ELGIN 5-5050 — Baltimore 2, Md. LEXINGTON 9-1900

CIRCLE 505 READER SERVICE CARD

MOTORS • GENERATORS
TRANSFORMERS
NEW & REBUILT

ELECTRIC EQUIPMENT CO.

WORLD'S LARGEST INVENTORY
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P. O. BOX 52 • ROCHESTER 1, N. Y.

CIRCLE 506 READER SERVICE CARD

TRANSFORMERS

BOUGHT • SOLD • RENTED
REWOUND • RE-DESIGNED
MANUFACTURED
Ask for our Stock List

For Sale

3—2500 KVA G-E 6900—2300Y
3—2500 KVA G-E 6900—2400/4160Y
3—2500 KVA G-E 6900—7200/12470Y
4—2500 KVA W-H 34500—2400/4800/11000
3—1500 KVA G-E 69000—2300Y
3—1500 KVA G-E 69000—2400/4160Y
3—1500 KVA G-E 69000—7200/12470Y

THE ELECTRIC SERVICE CO., 5322 Hetzel St., Cincinnati 27, Ohio
"America's Exclusive Independent Transformer Service Shop"

CIRCLE 507 READER SERVICE CARD

Equipment for Sale from Hahnemann Hospital

3—350 Horse power type "CP" Boilers installed in this plant and put into operation September 1937 to operate at 175# PSI present operation 90# PSI due to elimination of electric generating station and laundry.
6—FP-4 Fireye Controls National Airoil Burners
3—Blowers
1—Compressor, Westinghouse 3 YC with tank 150# operation 2 ph 220 v.
1—L.O. Pump, Gardner 3" suction 2" discharge.
3—Damper controls—Hagan Ranarex Control.
3—Roth, model 3751-3791 boiler feed pump 4" suction 125# 2½" discharge 250# with Bed-plates & 15 H.P. motor 2 ph 220 v operation.
1—Union Steam Pumps Vacuum Pump 15" Rebuilt 1957—size 10 x 14 x 16 Ser. #178278.
2—Union Steam Pumps for water 60# pressure Rebuilt 1957 10 x 8½ x 12—Ser. #204776-204777.
1—Cochrane Feed Water
1—Steam Driven Worthington fuse oil pump 2" suction—1½" discharge.
1—Shutte & Koerting Co. twin fuel pumps with strainers, valves 2 motors 2 ph-220 v operation 1 double bank fuel oil preheater. All cross connected piping to boilers, fuel oil pump, boiler feed pumps, main stop valves and safety valves on each boiler, main line pipe 10" with oil separators and all piping for 2 steam engines valved at 10".

HAHNEMANN MEDICAL COLLEGE and HOSPITAL
230 North Broad Street — Philadelphia 2, Pennsylvania

CIRCLE 508 READER SERVICE CARD

MISS POWER EQUIPMENT SAYS,

"For BIGGER SAVINGS and BETTER SERVICE, Get Our BARGAIN PRICES on Guaranteed NEW and REBUILT MOTORS"

SQUIRREL CAGE MOTORS NEW AND GUARANTEED

HP	Make	REBUILT Type	Speed
500	G.E. S.B. Open	IK	1200
400	West. S.B. Drip CSP-681		1800
400	L.A. S.B. Splash		1800
400	G.E. S.B. Open	IK	1200
400	West. S.B. Open	C9	900
350	West S.B. Drip CS-22586H		1200
300	L.A. S.B. Splash FX-1489		1800
300	G.E. S.B. Open	IK	1800
300	G.E. S.B. Open	IK	900
300	Cont. S.B. Splash N-804		900
300	G.E. S.B. Open	IK	720
300	G.E. S.B. Open KT-561		720
300	G.E. S.B. Open	IK	600
250	G.E. S.B. Open	KT	1800
250	West. S.B. Splash CS-875		1800
250	G.E. S.B. Open	IK	1200
250	G.E. S.B. Open	IK	900
250	G.E. S.B. Open	IK	720
200	G.E. S.B. Drip K-6825		1800
200	West. S.S.B. Open CS-855		1800
200	Cont. T.E.F.C.B.B. NF-743X		1200
200	West. S.B. Open	CS	1200
200	G.E. S.B. Open	IK-15	1200
200	G.E. S.B. Open	IK-156	1200
200	G.E. S.B. Open 2200 v.	IK	1200
200	G.E. S.B. Open	IK	900
150	West. T.E.F.C.B.B. CS-81205		1800
150	G.E. S.B. Drip K-6324		1800
150	West. S.S.B. Open CS-771-C		1800
150	Al. Chal. B.B. Open AR		1800
150	West. S.B. Open 2200V	CS	1800
150	West. S.B. Drip CS-772		1200
150	West. T.E.F.C.B.B. CS-775		1200
150	G.E. S.B. Open	KT	1200
150	G.E. S.B. Open KT-557		1200
150	Al. Chal. S.B. Open AR-826		900
150	Cont. T.E.F.C.B.B. N-743-X		900
150	Al. Chal. T.E.F.C.B.B. AZ		900
150	F.M. S.B. Open H-24A		900
150	G.E. S.B. Open	IK	900
150	G.E. S.B. Open	IK	720
125	G.E. T.E.F.C.B.B.	K	3600
125	Burke S.B. Open 440 Volt. N-565		3600
125	Reliance T.E.F.C. S.B. AA-3584		1800
125	G.E. S.B. Open	IK	1800
125	G.E. S.B. Splash K-565		1800
125	Al. Chal. S.B. Open AR		1800
125	G.E. S.B. Open KT-553		1200
125	Century S.B. Drip		1200
125	G.E. S.B. Open	IK	1200
125	Ideal S.B. Open A-585		1200
125	F.M. S.B. Open	H	900
125	G.E. S.B. Open	IK	720
125	G.E. S.B. Open	IK	600
100	Al Chal. T.E.F.C. B.B. ARZ-823		3600
100	C.W. S.B. Open 2300 Volt SC-445		3600
100	L.A. S.B. Drip New OGX-445		3600
100	U.S. S.B. Open 440 V SC-704		3600
100	G.E. S.B. Open KT-548		1800
100	G.E. S.B. Open K-504		1800
100	Cont. TEFCBB XP NP-505		1800
100	Al. Chal. S.B. Drip ARW-823		1800
100	West. TEFCBB CS-770		1200
100	G.E. S.B. Open KT-547		1200
100	Ideal S.B. Drip New A-584		1200
100	West. S.S.B. Open CS-754C		900
100	Al. Chal. T.E.F.C. B.B. XP 2SE8		900
100	F.M. S.B. Open H28C		900
100	Al. Chal. S.B. Open AR-823		900
100	F.M. S.B. Open	H	720
100	F.M. S.B. Open	H	600
75	G.E. S.B. Open	K-443	1800
75	Ideal S.B. Drip New A-505		1200
75	Sterling BB Drip SC-444		3600
75	L.A.S.B. Drip OGX-445		1800

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Motors, Control Equipment, AC and DC Generators, MG sets and transformers. PHONE or WIRE us COLLECT
LARGE LINE OF SLIP RING MOTORS & CONTROLS.

CASH FOR YOUR SURPLUS
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POWER EQUIPMENT CO.

8 CAIRN STREET • PHONE BEverly 5-1667 • P.O. BOX 514 • ROCHESTER 2, N.Y.

CIRCLE 509 READER SERVICE CARD

TRANSFORMERS—60 CYCLE

Qu	KVA	Make	Type	Phase	Voltages
2	3000	Moloney	TCR	3	7200/6600-4160/2400
2	750	G.E.	K	1	4600-120/240
1	300	Penna.	(Askarel)	3	12470Y/7200-240
2	250	G.E.	H Pyranol	1	4800/2820Y/120/240
3	200	Al.-Ch.	CRB	1	2400/4160-240/480
3	200	Amer.	CC	1	4160/7200-240/480
3	75	G.E.	KF	1	2400/4160-120/240
1	50	Amer.	Absetol	3	4160-120/208Y
3	50	Niagara	Dry	1	2400/4160Y-120/240
3	50	Harrison	Dry	1	2400/4160Y-220/440
2	3000	G.E.	OA-T	3	26,400-4160/2400
6	25	G.E.	Dry	1	2200-440

MOTOR GENERATOR SETS

Qu	KW	Make	Speed	DC	AC
1	75	EM	1200	250	Syn. 250V.
1	75	G.E.	1200	125	2300/4160 Syn.
1	175	West.	1200	125	4150 Syn.
1	300	G.E.	1200	250	2300/4160Y HR
1	300	Al.-Ch	1200	125/250	Syn. 440V.
1	1000	West.	720	600	2300/4160Y Syn.

ENGINE GENERATOR SETS

1—Hercules Gas HXE 62.5 KVA Weighs 3/60/480—1200

SLIP RING MOTORS

Qu	HP	Make	Speed	Type	Volts
2	40	West.	600	CW	220/440
1	60	G.E.	1800	MT	220
1	60	G.E.	850	MT548	440
1	75	G.E.	600	IM	440
1	100	West.	1800	T.E.F.C. B.B.	220
3	150	Allis-Ch.	1800	AY-BW	2300
1	250	West.	600	CW	440
1	350	West.	1800	CW	2300
1	450	West.	1800	CW-4-30-9	220
1	500	G.E.	450	MT	2300
1	800	G.E.	1200	M360Z	2300/4160Y
1	50	G.E.	870	MT552	220/440

D. C. MOTORS—230 VOLTS

Qu	HP	Make	Speed	Type
1	350	G.E.	1200	Pedestal
1	30	G.E.	1750	173 FR
1	30	West.	890/1400	SK-403343

SQUIRREL CAGE MOTORS, 3 PHASE, 60 CYC.

1—300 HP, 1200, Allis. Chalmers, 2300/4160Y
1—275 HP, 1130 RPM G.E. Type KT 500BS 2300V
2—200 HP, 1790 RPM, G.E. Elec. KP, TEFC, 2300V
3—150 HP, 1800 G.E. TEFC Exp. 220/440
1—100 HP, 1775 RPM G.E. KTP-543 3 ph 60-440V.
1—75 HP, 3600 RPM Cont. NP 505—440V Exp. P
1—50 HP, 3600 Cont. Ex. Pr. 220/440
3—100 HP, 3600 RPM Cont. NP 585-S 440V X.P.
1—100 HP, 1200 RPM West-CSP 220/440
1—200 HP, 450 RPM GE TS 7656 2200

MOTORS—SYNCHRONOUS—3 ph. 60 cy.

100 HP 900 RPM G.E. Fan BL 2200V.
125 HP 600 RPM G.E. Type TS 2200 V.
125 HP 900 RPM Elect. Mach. 4800 V.
150 HP 3600 RPM G.E. type TS Fr. 956Y 2300 V.
150 HP 1800 RPM G.E. Type TS 220 V.
200 HP 720 RPM Elec. Machinery L.e.f.c. 2300 V.
225 HP 900 RPM West—2300 V.
400 HP 450 RPM Westinghouse Type HR 440 V.
75 HP 1200 RPM Crocker-Wheeler Type ALT 220/440 V. B.B.

FOR POWER
J.L. HEMPHILL & CO.

CIRCLE 513 READER SERVICE CARD

SPECIAL OFFERING!

3 NEW UNUSED 850 KW DIESEL GENERATOR SETS

installed but never run

ENGINE:

Fairbanks-Morse model 38D8 1/8 — bore & stroke 8 1/8 x 10—@ 720 RPM.

GENERATOR:

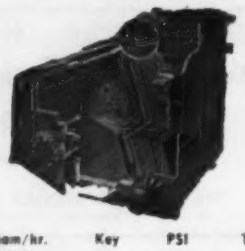
Complete—drip-proof enclosure—850 KW 440/3/60 @ 720 RPM—80% P.F.—with direct-connected 7 1/2 KW exciter and switchgear.

The above units are complete with filters, strainers, heat exchangers, mufflers, air intake silencers, etc., and are complete in every detail. They are mounted on a common pre-fab sub-base, and have the latest deadfront switchgear, distribution & voltage regulators. These units are perfect in every respect & have been carefully preserved by the U.S.N. Can be seen in our warehouse or aboard the "Hawaii."

THE BOSTON METALS CO.
313 E. Baltimore St., Baltimore 2, Md.
ELGIN 5-5050 — LEXINGTON 9-1900

CIRCLE 510 READER SERVICE CARD

BOILERS NEW UNASSEMBLED



# Steam/hr.	Key	PSI	Temp.
122,500	DF	565	850
121,650	DF	565	850
60,000	SF	435	750
74,000	H	280	500
55,000	A	240	—

DF Double Furnace, SF Single Furnace (illustrated), bent water tube boilers w/economizers and superheaters, B & W's and Foster Wheelers.
H Header type, straight tube, B & W.
A 3 drum, single furnace, Wickes.

Pelnik-Loconti Industrial Supply, Inc.
315 Oriskany St., Yorkville, N.Y.
Utica, N. Y. Ph. RE 6-4621, RE 2-4513

CIRCLE 512 READER SERVICE CARD

FOR SALE

1500 KW, 80% Power Factor, 3 phase, 60 cycle, 2300 volts, 3600 RPM, General Electric 5-stage noncondensing steam turbine generator unit, 375 PSIG, 700° FTT, 125# exhaust back pressure, complete with direct connected shaft exciter and switchgear. Excellent condition—available immediate delivery.

EUCLID ENGINEERING CORPORATION
909 National City East Sixth Building
Cleveland 14, Ohio

CIRCLE 514 READER SERVICE CARD

New and Used Equipment Available for
POWER PLANTS, SUBSTATIONS, TRANSMISSION LINES AND CONSTRUCTION
Send for new list
EBASCO SERVICES INCORPORATED
APPARATUS EXCHANGE Two Rector St., New York 6, N. Y.

CIRCLE 511 READER SERVICE CARD

FOR SALE
ATLAS IMPERIAL DIESEL

Model 26HS3358, Engine #12692 600 H.P. 300 RPM 6 cylinder, 15" Bore x 19" Stroke; 4 Cycle including New Maxim exhaust silencer, air starting equipment, oil filter & receivers. Heat exchanger with pumps. Recently overhauled. Now set up & we will be pleased to run for inspection. Can be seen anytime by appointment.

MERRIMAC HAT COMPANY, INC.
18 Cedar Street, Amesbury, Mass.
Tel. Amesbury, Mass. 1180

CIRCLE 515 READER SERVICE CARD

CONVERSION & POWER EQUIPMENT

M-G SETS—3 Ph. 60 Cy.

Qu.	KW	Make	RPM	DC Volts	AC Volts
1	4000/4800	G.E. (SU)	450	250/300	2300/4600
1	2500	Whse. (SU)	720	600	2300/4600
1	2400	G.E.	450	300	2300/4160
1	1750/2100	G.E.	514	250/300	2300/4600
1	2000	G.E.	514	600	2300/4600
1	1500	G.E.	720	600	4000/13200
1	1500	Cr.-Wh.	720	100	2300/4160
1	1250	Whse.	720	600	2300/4160
1	1000	G.E.	900	600	2300/4000
1	1000	G.E.	720	250	2300/4160
1	1000	G.E.	900	250	4000/9600
1	500	G.E.	900	125/250	440
1	500	G.E.	900	250	2300/4000
1	500	G.E. (new)	1200	300	2300
1	400	C.W. (SU)	1200	125/250	2300
1	250	G.E.	900	125	440/4160
2	300	G.E.	1200	250	2300
1	300	Whse.	1200	600	2300/4160
1	200	G.E.	1200	250/275	440
1	200	G.E.	1200	250/275	2300/4160

MERCURY ARC RECTIFIERS

Qu	KW	Make	Type	DC Volts	AC Volts
2	150	G.E.	HP 20	345	208
1	120	G.E.	6RP	275	2300/4160

FREQUENCY CHANGER SETS

Qu.	KW	Make	Freq.	Voltages
1	12500	Whse.	60/25/60	13200/13200
1	5000	G.E.	60/50/60	11000/6600
1	3500	G.E.	25/62½	2300/2300

TRANSFORMERS

Qu.	KVA	Make	Type	Ph.	Voltages
3	2333	Whse.	OISC	1	13800x2300
1	3000	A.C.	OISC	3	84500x2300
3	1000	G.E.	OISC	1	13800x460
3	833	A.C.	OISC	1	2400/4800Y480

TURBO GENERATORS

Qu.	KW	Make	Description
1	1000	G.E.	Non Cond. 125#/5-15# B.P. 2300V.
1	3000	G.E.	Cond. 600#-750° 2400/4160V.

A.C. MOTORS — 3 Ph. 60 Cy. Slip Ring

Qu.	HP	Make	Type	Volts	Speed
1	1750	G.E.	M-8798B	4000/6600	1800
1	800	Whse.	CW	350	1775
1	800	G.E.	MT-428	2200	450
1	600	Whse.	CW-333D-15	440	1775
1	600	Whse.	CW	440	850
1	450	Whse.	CW	440	352
	(Unused)				
1	500	Whse.	CW	2300	880

SQUIRREL CAGE

1	550/275	Whse.	CR-1115	2300	450/900
1	800	G.E.	FT-550Y	2300	3600
2	300	Whse.	CSP-563H	440	3600
4	500	Whse.	CR-1216	2200	600
2	450	Elliott	2010	2200	1185
1	400	Whse.	CR-7181	4000/6600	3600
1	300	Whse.	CR-100Z	2300	600
1	300	G.E.	KT-859A	2300	1775

SYNCHRONOUS

1	7000	G.E.	ATI	2300/6600	600
1	3500	G.E.	TS-6487	2200/4000	300
2	1750	G.E.	ATI	2200	3600
1	325	G.E.	ATI	440	1800

RE-NU-BILT BY

BELYEA COMPANY, INC.

43 Howell St., Jersey City 6, N. J.

Tel: OLDFIELD 3-3334

Circle 516 on Reader Service Card

UNUSED—ASSEMBLED—NEW

IN ORIGINAL MANUFACTURER'S PACKING CRATES

BOILERS (Package type)

B&W—60,000 lbs./hr.—475 psig., 740°TTF, oil fired (shipped intact as one integral unit)
B&W—122,500 lbs./hr.—635 psig., 850°TTF, oil fired (unassembled)
B&W—153,600 lbs./hr.—634 psig., 850°TTF, oil fired (unassembled)

TURBOGENERATORS

4600 KW GE Turbine—Gen Set, Cond 410psi, 725°TTF, 28.5 Hg exh, 3/90.3/2700V PF 1.0—New
1800 KW GE Turbine—Gen Set, Cond 410psi, 725°TTF, 28.5 Hg exh, 3/60/1735 V PF 0.8—New
1500 KW Westinghouse—Gen Set, Non Cond 400psi, 3/60/480V PF 0.8
1000 KW Westinghouse Turbine Gen. Set. Non. Cond. 190psi, 600°TTF, 3/60/480V/3600RPM PF 0.8

STEAM TURBINES

1000 SHP GE Cruising Cross Compound, 525psi, 825°TTF, 81psi exh, 10,119/350 RPM with Falk reduction gears—New
3000 SHP GE HP Main propulsion turbine 410psi, 9040RPM, 725°TTF } 1 Set—New
3000 SHP GE—LP Main propulsion turbine 40psi, 9040RPM
11,550 SHP GE HP 12 Stage Cross compound turbine 525 psig, 825°TTF 5870RPM } 1 Set—New
13,450 SHP GE LP 48psig, 4714RPM with Westgh speed decreaser gear assy.
294 HP Worthington-Moore, Non-Cond. Form #82R, 310psig, 650°TTF, 2psi-exh, 3560RPM
250 HP Sturtevant non-condensing Turbine—575psi, New

PUMPS, CENTRIFUGAL (Motor driven)

283 GPM @ 375'TDH, Ingersoll Rand—2GT, w/60HP 3525RPM 3/60/220/440V (Used)
275 GPM @ 635'TDH, Ingersoll Rand—2GT, w/75HP 3525RPM 2/60/2300V (Used)
200 GPM @ 1300'TDH, Ingersoll Rand—½CNTA, w/Base, Motor optional

PUMPS, CENTRIFUGAL (Turbine driven)

460 GPM @ 750psi discharge, Worthington, w/350HP turbine, 575psi, 4900RPM—New

BLOWERS, TURBO-CENTRIFUGAL

20,000 CFM @ 17"WC, Westinghouse, Vaneaxial, w/Turbine, 82.5HP, 375psi, 10psi—exh, 4625RPM—New
24,000 CFM @ 28"WC, Sturtevant Co, Rexvane, w/Turbine, 191HP, 400 psi, 10psi—exh, 3525RPM—New
31,250/24,000 CFM @ 45"/28" W.C. Sturtevant Propeller-Fan w/1602HP, 575psi, 15psi exh, 5850/4600RPM

WABASH POWER EQUIPMENT CO.

9750 SKOKIE BLVD., CHICAGO, ILLINOIS—TEL. OR 3-8118

3757 Wilshire Blvd. Los Angeles 5, Cal. | 1684 Hudson San Francisco, Cal. | 730 Dearborn Seattle, Washington

Circle 517 on Reader Service Card

COMPRESSORS

No better values at any price

74 CFM	1500 PSI	6½-3¾-1⅝x7 CP. TCB3
106 CFM	150 PSI	8x7 Ing. ES-1
104 CFM	2500 PSI	6¾-4½-1-11/16x9 IR-ES3
138 CFM	100 PSI	7x7, Ing. ES, CP & Joy
151 CFM	3000 PSI	13¾x12 Norwalk TRS-4T
288 CFM	100 PSI	9x9 Ing. Worth. CP
321 CFM	125 PSI	10x11 Ch. Pn. T
351 CFM	350 PSI	11-5x11 CP TCB-2
364 CFM	100 PSI	10x9 Joy WG9
465 CFM	100 PSI	12x11-1R-ES-1"Chic. P.T.
502 CFM	125 PSI	12x13 Worth HB
660 CFM	125 PSI	11½-7x7 Joy Wa 102
686 CFM	100 PSI	14x13 Ing. ES
877 CFM	125 PSI	17-10½x14 IR, XRB-CV
1055 CFM	110 PSI	18-11x12 Ch. Pn. OCE
	175 HP	3-60-200 (Excellent)
1665 CFM (actual)	100 PSI	C300-300H Fuller

AMERICAN AIR COMPRESSOR CORP.

Chem. Road, North Bergen, N.J. UN 5-1397

Circle 518 on Reader Service Card

1—Gardner-Denver air compressor, 445 cfm @ 100# pressure, 6 cylinder, 2-stage, 1952. Req. 100 HP.

2—E. Keeler 200 HP water-tube boilers, 100 psi, Stoker fired, 1945.

1—Babcock & Wilcox #32E coal pulverizer, air swept, 75 HP.

1—24" x 538' long trough belt conveyor.

PERRY EQUIPMENT CORP.

1422 N. 6th St., Philadelphia 22, Pa.

Phone: POplar 3-3505

Circle 519 on Reader Service Card

AUTOMATIC VOLTAGE REGULATORS

Complete stock of Allis Chalmers, General Electric and Westinghouse, new — unused. Save $$$

ELECTRIC POWER EQUIPMENT COMPANY
15 SO. ELM ST. DENVER 22, COLO.

Circle 520 on Reader Service Card

ELECTRICAL POWER EQUIPMENT

SLIP RING MOTORS

3 ph 60 cy 220 or 440 volts

HP	RPM	MAKE	TYPE
1500	514*	AL.-Ch.	Mill Type
1200	389*	AL.-Ch.	Mill Type
900	160*	AL.-Ch.	Mill Type
600	1800*	Gen. Elec.	M-6345B, Dppf, New
500	1200	Gen. Elec.	M-6345Z, Dppf.

*2200 volts or higher

SQUIRREL CAGE MOTORS

3 ph. 60 cy. 220 or 440 volts (*2200 volts or higher)

HP	RPM	MAKE	TYPE
1250	3600*	AL.-Ch.	ANX
800	1800	West.	CB34C
600	600*	West.	CS-44-C15 Dppf (2)
500	1200	G.E.	I-K
400	1800*	L. Allis	BB, Sppf.
400	1800	West.	BB, Dppf.

MOTOR GENERATOR SETS

KW	Make	Motor A.C.V.	Generator D.C.V.
1000	West.	4160	250
800	G.E. (3 unit)	2300/4160syn.	125/250
500	West.	2300/4160syn.	125/250
400	Al.-Ch.	2300/4160syn.	125/250
300	West.	2300/4160syn.	250
200	Rel.	2300/4160syn. TS	500
200	G.E.	2300/4160syn. TS	250/275

TRANSFORMERS

Special Offer — Like New

3—1250 KVA Allis Chalmers Class OA Oil filled Sgl ph 60 cy 34,000 Volt primary, 480 volt secondary with taps, manufactured 1955.

Write for current complete stock lists on electrical power equipment you need or send your list of surplus and used equipment for our offer.

Phone CAnal 6-2900

CHICAGO Electric Co.

1320 W. CERMAK ROAD • CHICAGO 8, ILL.

Circle 521 on Reader Service Card

37 Years Dependable Service

SLIP RING MOTORS 3 Ph., 60 Cy.

H.P.	Volts	Make	Speed
500	4000/2300	G.E.	600
450	4000/2300	G.E.	1200
400	2300/440	G.E.	600
400	4000/2300	Whse.	720
300	4000/2300	G.E.	720
300	2300	G.E.	900
300	440	G.E. (hoist)	600
300	440	Whse.	3600
225	4000/2300	G.E. (hoist)	600
200	2300	G.E.	600
200	2300/440	G.E.	720
125	2300	G.E.	600

AC GENERATORS or SYN MOTORS, 60 Cy.

H.P.	Volts	Make	Type	R.P.M.
400	2300	G.E.	TS	1800
400	2200/440	G.E.	ATI	720
300	2200/440	G.E.	TS	1200
200	440	G.E.	TS	600
150	440/220	Whse.	C	1200
125	440/220	Whse.	HR	400

SQUIRREL CAGE MOTORS

500	2200/4000	Elliott	SC	1800
400	2300	G.E.	PT	3600
400	2300/4000	G.E.	K	1200
350	2200/4000	G.E.	SKDP	3600
350	2300/4000	G.E.	K	600
300(2)	2300	G.E.	PT	3600
300	2300/4000	L. Allis.	FS	1800
300	2300/4000	Cont'l.	Spl. Prf.	720
300	2300/400	G.E.	KT	600
250	2300/4000	G.E.	K	720
200	2300	G.E.	KT	1800
200	2300	Cont.	TEFC	3500
150	440	Whse.	X-pf.	3600
150	440/220	Cont'l.	X-pf.	1800
150	440/220	G.E.	TEPT	720
150	2200/440	G.E.	TEFC	3600
125	2200/440	G.E.	PT	1200
100	440	Whse.	X-pf.	3600
100(2)	440	Cont.	X-pf.	1800
100(3)	4000/2300	L. Allis	OX	1200
100	2300	Cont'l.	OX	1200
60(2)	440	Cont'l.	X-pf.	1800

CIRCUIT BREAKERS, 3 Pole

4—1800 Amp., DA-50, Whse., 600 V., Air
1—600 Amp., G.E., 15 KV, Sol. oper.
2—600 Amp., G.E., 15 KV, manual
1—600 Amp., Whse., 7.5 KV, outdoor, New.

D. C. MOTORS

H.P.	Volts	Make	Type	Speed
150	230	El. Dyn.	B/brg.	800
90	230	G.E.	CD	1750
80	230	G.E.(4)	CD	1150

MOTOR GENERATOR SETS

KW	Make	Input., AC	Motor Type	Output V., DC
300	Whse.	4150/480	Syn.	250/125
150	G.E.	440/220	Syn.	250
125	G.E.	440/220	Sq. Ca.	125
100	G.E.	2200/440	Syn.	250
75	Cr. Wh.	440/220	Sq. Ca.	240/120
65	G. E. B	2200/440	Sq. Ca.	250

TRANSFORMERS 60 Cy.

1—500 kva, Al Ch. 2400/4160Y—600 volts, 3 ph.
2—500 kva, G.E., 12800—240/480 V.
2—200 kva, Mol., 13,800—2300 V.
2—333 kva, G.E., 13,800—2400 V.
2—333 kva, G.E., 2400—240/120 V.
2—333 kva, Mol., 2400—240/480V.
2—200 kva, G.E., 2400—480V, Pwr.
2—200 kva, G.E., 13,800—480 V.
2—200 kva, G.E. 4156—480/240 V.
2—167 kva, Whse., 4156—480 V.
2—156 kva, Al Ch., 2400—230 V.
2—150 kva, G.E., 12,200—2300 V.
2—100 kva, Whse., 2400—240/480 V., Dry
2—100 kva, G.E. 2400—120/240 V., Pwr.

GASOLINE—ENGINE GENERATOR SETS

2—37½ kva, 1800 R. 230 V 3/60, Cont'l., 4 cyl.
only partial listing

STEPHEN **HALL** & CO.
HARRY J. RICE, Pres.
625 ADAMS ST., HOBOKEN 2, N. J.

Circle 522 on Reader Service Card

MODERN POWER BOILERS

2—Babcock & Wilcox	—265,000 #/h	—750 psi
1—Combustion-Engineering	—110,000 #/h	—675 psi
1—Riley	—100,000 #/h	—456 psi
1—Babcock & Wilcox	—100,000 #/h	—450 psi
1—Babcock & Wilcox	— 90,000 #/h	—265 psi
1—Combustion-Engineering	— 75,000 #/h	—250 psi
1—Babcock & Wilcox	— 70,000 #/h	—450 psi
1—Riley	— 60,000 #/h	—265 psi
1—Combustion-Engineering	— 54,000 #/h	—250 psi
2—Combustion-Engineering	— 50,000 #/h	—250 psi
1—Babcock & Wilcox	—45,000 #/h	—450 psi
1—Foster-Wheeler	— 40,000 #/h	—200 psi
2—Babcock & Wilcox	—40,000 #/h	—250 psi
1—Babcock & Wilcox	— 27,500 #/h	—450 psi
1—Edgemoor	— 25,000 #/h	—450 psi
2—Riley	— 21,000 #/h	—250 psi
2—Riley	— 18,000 #/h	—200 psi

MIDWEST BOILER & TURBINE CO.
WARNER, NEW HAMPSHIRE

Circle 536 on Reader Service Card

AUTOMATIC and MANUAL
Gas or DIESEL GENERATOR UNITS
Complete Switchboard Design and Construction
USED & REBUILT EQUIPMENT
UNIVERSAL POWER ENGINEERING CO.
382 Wayne St. Jersey City, N. J.
Phone: DElaware 2-8300

Circle 527 on Reader Service Card

BOILERS

4 Cleaver Brooks Boilers

Model CB 720-20

Immediately available due to plant expansion at new location.

Each boiler is self contained and complete. 200# S W P, gas fired rated, 358 sq. ft. heating surface. Maximum capacity 2760# steam per hour. F. I. A. approved. Indicator Lights read "Fire—On", "Flame Failure" and "Low Water". Also, each equipped with Bronze Fitted Turbine Type Boiler Feed Pump complete with motor and starter, 2" Reynolds Gas Regulator, Steel Stack, 42" x 72"—432 Gal. horizontal combination make-up Tank and Receiver.

One (1) Klaxon Alarm complete with control equipment to produce Low Water alarm signals for any one of the four boilers. Also, one (1) water softener unit complete to service the four boilers.

Boilers installed new in 1959 and used approximately ten (10) months. Still installed and can be seen on original location. Subject to prior sale.

For inspection trip, call or write: T. T. Thompson.

DAYCO CORPORATION
(formerly Dayton Rubber)
DAYTON, OHIO

Circle 523 on Reader Service Card

NEW EQUIPMENT

from the unfinished Battle Cruiser "Hawaii"

Material installed but unused, and all in prime condition

8 B&W BOILERS

150,000 lbs/hr—684 lbs. WP—850°TT—6053 sq. ft. generating surface. (Can be converted to natural gas or #2 oil) 11' wide—21' high—15' deep.

4 LARGE DEAERATING FEED HEATERS

633,820 lbs/hr—manufactured by Worthington—test pressure 45 pounds.

8 MAIN CONDENSATE PUMPS

4 motor driven—4 turbine driven—400 GPM @ 56 lbs—11.5" submergence—1170 RPM—BHP 27.3 (Motor driven: GE 30 HP motor 440/3/60—1170 RPM. Turbine driven: Sturdevant turbine—990 lbs —20 lbs. S.P.—27.3 BHP @ 5460 RPM—gear 1170 RPM—1230 lbs. steam/hr.)

THE BOSTON METALS CO.
313 E. Baltimore St., Baltimore 2, Md.
ELGIN 5-5050 — LEXINGTON 9-1900

Circle 524 on Reader Service Card

WATER FILTRATION SYSTEM

In first class condition for sale. 1800 gpm diatomaceous earth water filter and carbon purifier system including all auxiliary appurtenances. Units available for immediate shipment. Purchased new in 1958 —used one year.

Original cost $66,500.00. Bids solicited.

FS-5426, POWER
520 N. Michigan Ave., Chicago 11, Ill.

Circle 525 on Reader Service Card

SEARCHLIGHT EQUIPMENT LOCATING SERVICE

No Cost or Obligation

This service is aimed at helping you, the reader of "SEARCHLIGHT", to locate Surplus new and used power equipment not currently advertised. This service is for USER-BUYERS only. How to use: Check the dealer ads to see if what you want is currently advertised. If not, send us the specifications of the equipment and/or components wanted on the coupon below, or on your own company letterhead to:

SEARCHLIGHT EQUIPMENT LOCATING SERVICE
Classified Advertising
c/o POWER
P.O. Box 12, N. Y. 36, N. Y.

Your requirements will be brought promptly to the attention of the equipment dealers advertising in this section. You will receive replies directly from them.

SEARCHLIGHT EQUIPMENT LOCATING SERVICE
Classified Advertising
c/o Power,
P.O. Box 12, N.Y. 36, N.Y.

Please help us to locate the following used equipment:

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NAME .....

TITLE ..... COMPANY .....

STREET .....

CITY ..... ZONE ..... STATE .....

11/60

NEW EQUIPMENT FROM THE UNCOMPLETED

BATTLESHIP U. S. S. KENTUCKY

Installed but never used
Built of finest materials

WESTINGHOUSE 1250 K.W. TURBO-GENERATORS

(4)—Westinghouse—440/3/60—850°—540 lbs. working pressure. Complete with condensers, circulating pumps, etc.

BOILERS

7 B&W EXPRESS TYPE

Design pressure 634# — operating pressure 565# — temp. 850°F. Oil fired — separately fired superheaters. *Capacity: 210,000* lb. steam/hr. ideal for testing where large quantities of steam are required, giving excellent control from separately fired superheaters. Can be converted for #2 oil and natural gas. Fully automatic.

LARGE DEAERATING FEED HEATERS

Monel construction—spray type—capacity 480,000 lbs./hr.—vent condenser—single pass—heating surface 174 sq. ft.—all Monel construction.

GE HIGH AND LOW PRESSURE MAIN PROPELLING TURBINES

Will sell separately for testing, wind tunnel or similar work. (2) high pressure—24,400 HP—12 impuse stages—4909 RPM—working pressure 540 lbs.—825°F. (2) low pressure—28,600 HP — 3913 RPM — working pressure 49 lbs. steam—424°F—2-6 stages of impulse.

FEED PUMPS

Ingersoll-Rand—5"—three stage—500 GPM at 750 lb. discharge. BHP 330—5000 RPM—Worthington turbine—573 lbs.—non-condensing—back pressure 20 lbs.

FORCED DRAFT BLOWERS

29,000 CFM—max. static 35"—normal 21"

LUBE OIL COOLERS

MANY OTHER ITEMS FOR SALE.
SEND US A LIST OF YOUR REQUIREMENTS

THE BOSTON METALS CO.

313 E. Baltimore St., Baltimore 2, Md.
ELGIN 5-5050 — LEXINGTON 9-1900

Circle 528 on Reader Service Card

FOR SALE

Copper Tank about 3500 gal capacity, 8 foot diameter by 9 feet high, 3/16" copper. Has manhole in top and several taps on side with one in bottom—welded seams. Can be seen in Mechanicsville, N. Y. Used for distilled water. Make an offer.

FS-5258, POWER
Class. Adv. Div., P.O. Box 12, N.Y. 36, N.Y.

Circle 529 on Reader Service Card

BARGAINS!

1050 HP FAIRBANKS-MORSE DIESEL MODEL 32, 7 CYL., 257 RPM, 726 KW, FM 3/60/2400 WITH EXCITER, SWITCHBOARD, ETC. VERY LOW PRICE.

3000 CFM WORTHINGTON AIR COMPRESSOR 2 STAGE, HORIZONTAL, 164 RPM, 5 STAGE CONTROL. 650 HP 3/60/440 SYNCHRONOUS MOTOR. COMPLETE ACCESSORIES.

WHISLER EQUIPMENT CO.
1908 Railway Exchange Building
St. Louis 1, Mo.

Circle 530 on Reader Service Card

CHECK WITH WAGNER FIRST!

Thousands of new and "Certified Rebuilt" Motors & Generators in stock—up to 1000 H.P.

OUR 54th YEAR

A. C. MOTORS—60 CYCLE

HP	Mfr.	Type	Volts	Speed
800	Whse. (2)	Sq. Cage	2300	1800
750	G.E.	Slipring	2300	514
600	G.E.	Synch.	480	900
600	Elliott (2)	Sq. Cage	2300	900
500	Al. Ch. 2 brg.	Slipring	440	514
500	Allis Ch.	Slipring	2300/440	600
400	Whse.	Sq. Cage	2200	514
400	Marathon (2)	Sq. Cage	2300	3600
400	G.E.	Slipring	2200/4000	720
400	El. Machy.	Synch.	2300/4000	600
350	El. Machy.	Synch.	2300	900
350	G.E.	Sq. Cage	2200	1800
400	G.E.	Slipring	2200/440	600
300	G.E.	Slipring	220/440	514
250	G.E.	Sq. Cage	2200/440	1200
250	Gen. Elec.	Sq. Cage	440	3600
250	Whse.	Sq. Cage	2300/440	600
250	Whse. (4)	Slipring	2300/440	600
200	Gen. Elec.	Synch.	550/440	400
200	G.E. b.b.	Sq. Cage	220/440	720
200	G.E.	Slipring	220/440	450
200	G.E.	Slipring	440	600
200	G.E.	Slipring	2300	900
200	Reliance b.b.	Sq. Cage	220/440	1800
200	Allis Ch.	Slipring	2300/440	720
200	G.E. b.b.	Sq. Cage	2300	900
200	A.C. TEFC	Sq. Cage	2300/440	1200
150	Cr. Wheeler	Sq. Cage	440	450
150	G.E. TEFC (2)	Sq. Cage	220/440	900
150	Whse. XP	Sq. Cage	440	3600
150	G.E. (4)	Slipring	2300/440	600
150	Whse.	Slipring	220/440	1200
125	Whse. b.b.	Sq. Cage	220/440	900
125	A.C. TEFC	Sq. Cage	220/440	1800
125	El. Machy. (2)	Synch.	220/440	400
125	G.E. TEFC	Sq. Cage	2200	3600
125	Al. Ch. TEFC	Sq. Cage	220/440	600
125	G.E. (2)	Slipring	220/440	514
100	Allis Ch.	Slipring	2300/440	600
100	Al. Ch. TEFC	Sq. Cage	2200	1800
100	G.E. TEFC-XP	Sq. Cage	220/440	1200
100	G.E. b.b.	Sq. Cage	220/440	3600
100	G.E. (2)	Slipring	220/440	1200
75	G.E. b.b. (8)	Sq. Cage	220/440	1200

D. C. GENERATORS

KW	Mfr.	Type	Volts	Speed
200	Gen. Elec.	CY-221	250/350	1200
200	Gen. Elec.	RC	250	1450
150	Delco b.b.	late	120/240	1200
75	Allis Ch. b.b.	KB-146L	125	1500
60	Ideal	D	125	1150
60	G.E. b.b.	CD	600	1750
50	G.E. (2)	CD-1129	250	1200

D. C. MOTORS

HP	Mfr.	Type	Volts	Speed
250	Cr. Wh.	101-H	230	1150
200	G.E. (2)	RC-38	230	1150
200	Whse. b.b.	SK	250	287/575
150	Rel. TEFC b.b.	2556-F	230	850
150	Whse.	SK-210	230	320/1000
125	G.E.	CD-172	230	575/1150
100	Elliott b.b. T.E.	JH-FE	230	1150
100	El. Dyn. b.b. (2)	30-S	230	450/1200
100	G.E. crane	CO-1831	230	675
75/100	Whse.	SK-191	230	300/900
60	G.E. TEFC b.b.	CD-135	230	1150
30/40	L.A. b.b. (2)	ONW	230	500/1500
35/50	Rel. b.b. (2)	461-T	230	300/1200

MOTOR-GENERATOR SETS

KW	Mfr.	Input V	Output V
600	Allis Ch.	440 AC	250 DC
300	G.E.	440 AC	250/350 DC
200	Allis Ch. (2)	440 AC	250 DC
200	Whse. synch.	220/440 AC	55 DC
200	Gen. Elec.*	220/440 AC	125 DC
125	Whse.	220/440 AC	250 DC
100	Delco b.b.	220/440 AC	120/240 DC
80	Star b.b. Synch.	220/440 AC	250 DC
75	Whse. Synch.	220/440 AC	250 DC
60	Ideal	220/440 AC	125 DC
50	Whse. synch.	220/440 AC	250 DC
30	G.E. (2)	220/440 AC	125 DC
30	Whse.	220/440 AC	250 DC

Arthur Wagner Co. Certified

MO nroe 6-7409
1435 W. RANDOLPH ST
CHICAGO 7, ILLINOIS

Circle 533 on Reader Service Card

POWER EQUIPMENT

15000 KW, **NEW**, Cond. Turbo-Generator 3/60, 13800 V., 3600 RPM. 850 PSIG, 900°TT with boiler.
5500 KW, G.E., Non C. Turbo-Gen. 3/50, 2300 V, 3000 RPM 600 PSIG 650°TT, 150 PSIG Exh.
1500 KW, G.E. Cond. Extr. Turbo-Gen. 3/60, 2400 V., 3600 RPM, 200/400 PSIG, 750°TT, 3# A.E.
1000 KW, Worth.-Moore, Cond. Extr. Turbine, 3/60, 245/490V, 3600 RPM 130-300 PSIG, 10# Extr.
300 KW, G.M. 8-268A, Diesel Units (2) 3 ph. 60 cycle, 480 V, 1200 RPM
500 KW, .8 P.F. West. 3/60, 240/480 V 300 RPM, Gen. direct conn. to Ames Vertical Uniflow Engine.

BREW, WOLTMAN
& COMPANY, INC.
50 CHURCH ST., N.Y. 7, N.Y.

Circle 531 on Reader Service Card

FOR SALE

1050 KVA DIESEL UNIT

1050 KVA Nordberg supercharged diesel engine generator unit, 3 phase, 60 cycle 2400 volts, 327 RPM.

New 1947 — Excellent condition.

The above unit is still installed and complete with all auxiliaries as in operation. Can be adapted for dual fuel operation.

International Power Machinery Co.
1612 Union Commerce Bldg.—MAin 1-9514
Cleveland 14, Ohio

Circle 532 on Reader Service Card

POWER EQUIPMENT DIVISION

GENERATOR SETS

11—1250 KVA Natural Gas Engine Sets 3/60/2400/4160 with switch gear (can be seen running)
1—500 KW Condensing 200 PSI Turbine

TRANSFORMERS

1—6000 KVA 3/60/44000—4160 Substa.
3—500 KVA 1/60/66000— 480
6—450 KVA 3/60/13800— 460
3—333 KVA 1/60/2300/4160 Y—480

BOILERS

40,000#/hr. 225 PSI B&W Type F22
25,000#/hr. 450 PSI @ 738°F. Stirling
18,000#/hr. 160 PSI Keeler

NEW UNASSEMBLED B&W, F.W., C.E. complete with Superheater, Economizer, Soot Blowers, Oil Burners, Steel Encased
44500#/hr. 450 PSI 735°F.
35000#/hr. 285 PSI 577°F.

CRANES

40/10 ton OET 47'3" Span 75' Lift AC
25 ton Powerhouse 36'6" Span AC
6 ton OET 43' Span 20' Lift DC

HEAT & POWER CO. INC.
60 East 42nd St., New York 17, N.Y.
310 Thompson Bldg., Tulsa 3, Okla.

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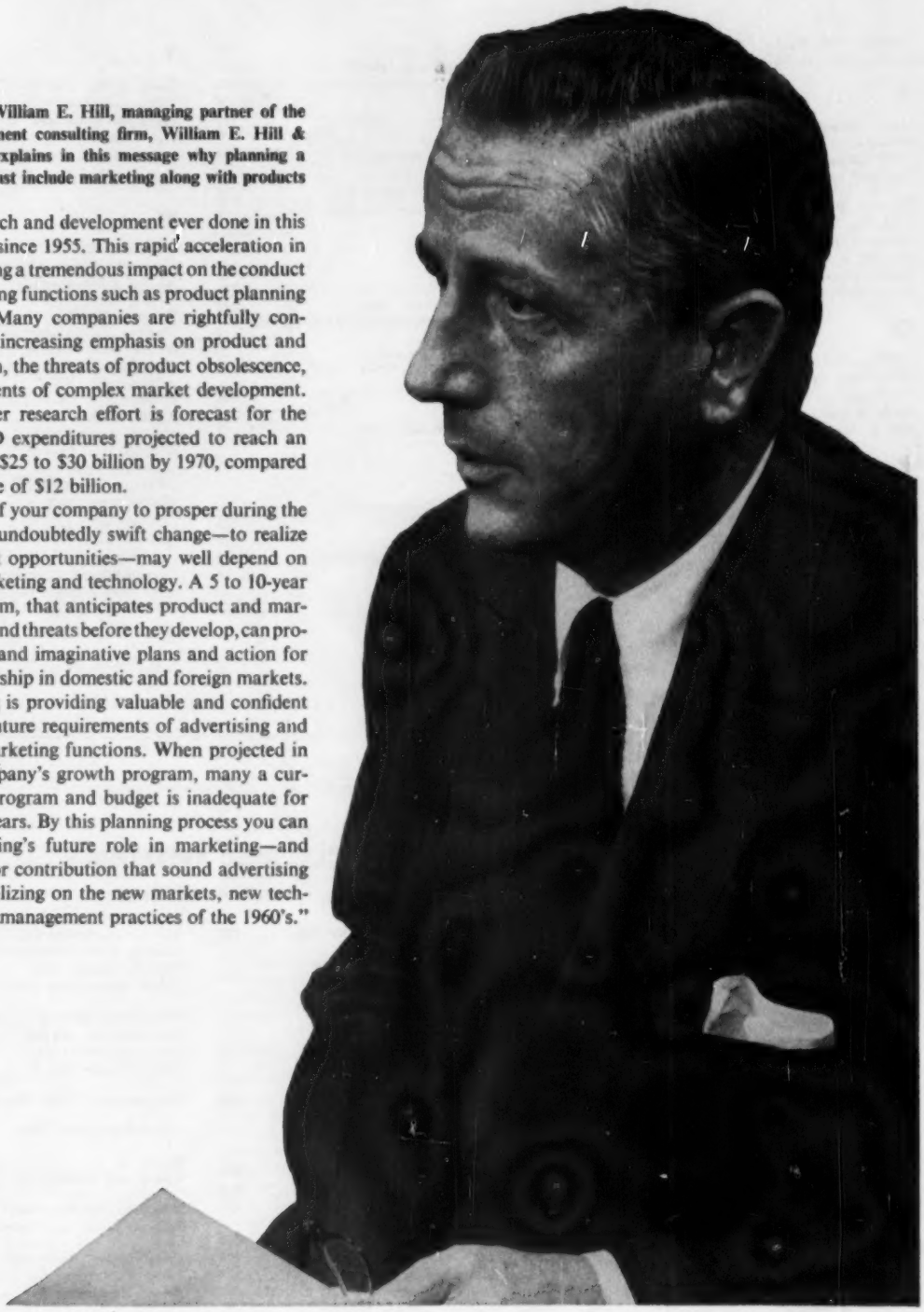
"Long-range planning for advertising?"



"Certainly," says William E. Hill, managing partner of the New York management consulting firm, William E. Hill & Company, and he explains in this message why planning a company's future must include marketing along with products and processes.

"Half the research and development ever done in this country has been since 1955. This rapid acceleration in technology is having a tremendous impact on the conduct of specific marketing functions such as product planning and advertising. Many companies are rightfully concerned about the increasing emphasis on product and process innovation, the threats of product obsolescence, and the requirements of complex market development. And still a greater research effort is forecast for the 1960's, with R&D expenditures projected to reach an estimated level of $25 to $30 billion by 1970, compared with a present rate of $12 billion.

"The capacity of your company to prosper during the next ten years of undoubtedly swift change—to realize the period's profit opportunities—may well depend on your creative marketing and technology. A 5 to 10-year long-range program, that anticipates product and market opportunities and threats before they develop, can provide the advance and imaginative plans and action for competitive leadership in domestic and foreign markets.

"Such planning is providing valuable and confident insight into the future requirements of advertising and its companion marketing functions. When projected in relation to a company's growth program, many a current advertising program and budget is inadequate for the next 5 to 10 years. By this planning process you can optimize advertising's future role in marketing—and establish the major contribution that sound advertising can play in capitalizing on the new markets, new technologies and new management practices of the 1960's."

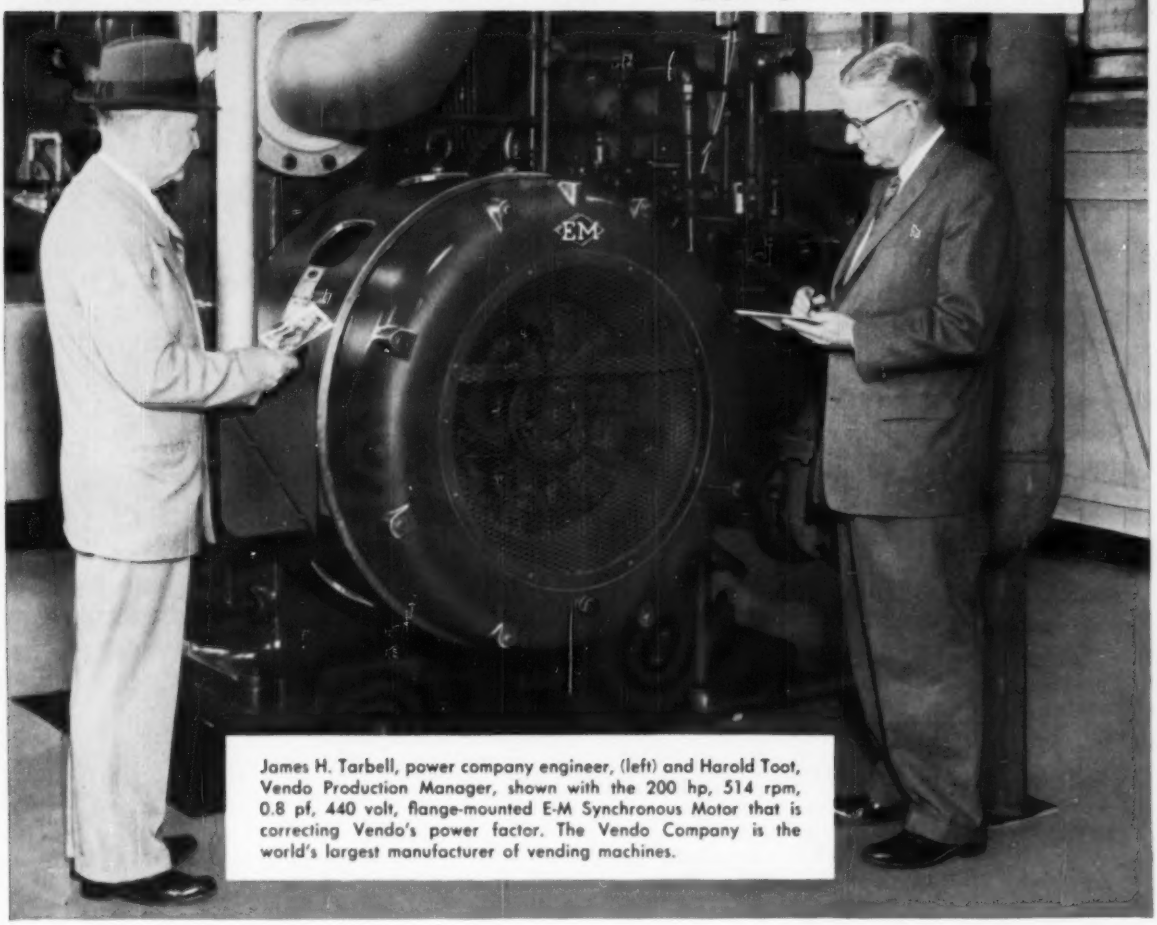
AIA

ASSOCIATION OF INDUSTRIAL ADVERTISERS

271 madison avenue • new york 16, n. y. • telephone murray hill 5-8921

An organization of over 4000 members engaged in the advertising and marketing of industrial products, with local chapters in ALBANY, BALTIMORE, BOSTON, BUFFALO, CHICAGO, CLEVELAND, COLUMBUS, DALLAS, DENVER, DETROIT, HAMILTON, ONT., HARTFORD, HOUSTON, INDIANAPOLIS, LOS ANGELES, MILWAUKEE, MINNEAPOLIS, MONTREAL, QUE., NEWARK, NEW YORK, PHILADELPHIA, PHOENIX, PITTSBURGH, PORTLAND, ROCHESTER, ST. LOUIS, SAN FRANCISCO, TORONTO, ONT., TULSA, YOUNGSTOWN.

Are You Paying Big Penalties for Lagging Power Factor?



James H. Tarbell, power company engineer, (left) and Harold Toot, Vendo Production Manager, shown with the 200 hp, 514 rpm, 0.8 pf, 440 volt, flange-mounted E-M Synchronous Motor that is correcting Vendo's power factor. The Vendo Company is the world's largest manufacturer of vending machines.

Vendo Company Corrects Power Factor... SAVES $450 A YEAR! with an E-M Synchronous Motor

The Vendo Company, Kansas City, Missouri learned its plant was operating at a lagging power factor condition when expanded production facilities required more compressed air. A study by Vendo's engineers and Kansas City Power & Light Company showed an 0.8 leading power factor synchronous motor compressor drive would save them money. Here's how:

Vendo's power contract provides a penalty of 20 cents a month for every reactive kva exceeding one-half the maximum kilowatt demand. *This was costing Vendo $33.00 per month, or $396.00 a year!*

A 20 cents a month bonus is granted for every kilovar the reactive demand falls short of one-half the maximum kilowatt consumption. A 200 hp E-M Synchronous Motor with 0.8 pf would provide enough reactive kva for Vendo to operate at a *leading* power factor and earn a monthly credit of $4.60. Vendo's power bill would then be reduced by $37.60 a month, or $451.20 a year!

Vendo installed the recommended E-M Synchronous Motor . . . and has been enjoying a reduced power bill ever since. You, too, can make a big saving in your plant power bill by correcting your power factor with highly efficient E-M Synchronous Motors.

Learn more about Power Factor. Call your nearby E-M Sales Engineer and write for your free copy of the new E-M 24-page brochure, *The ABC of Power Factor.*

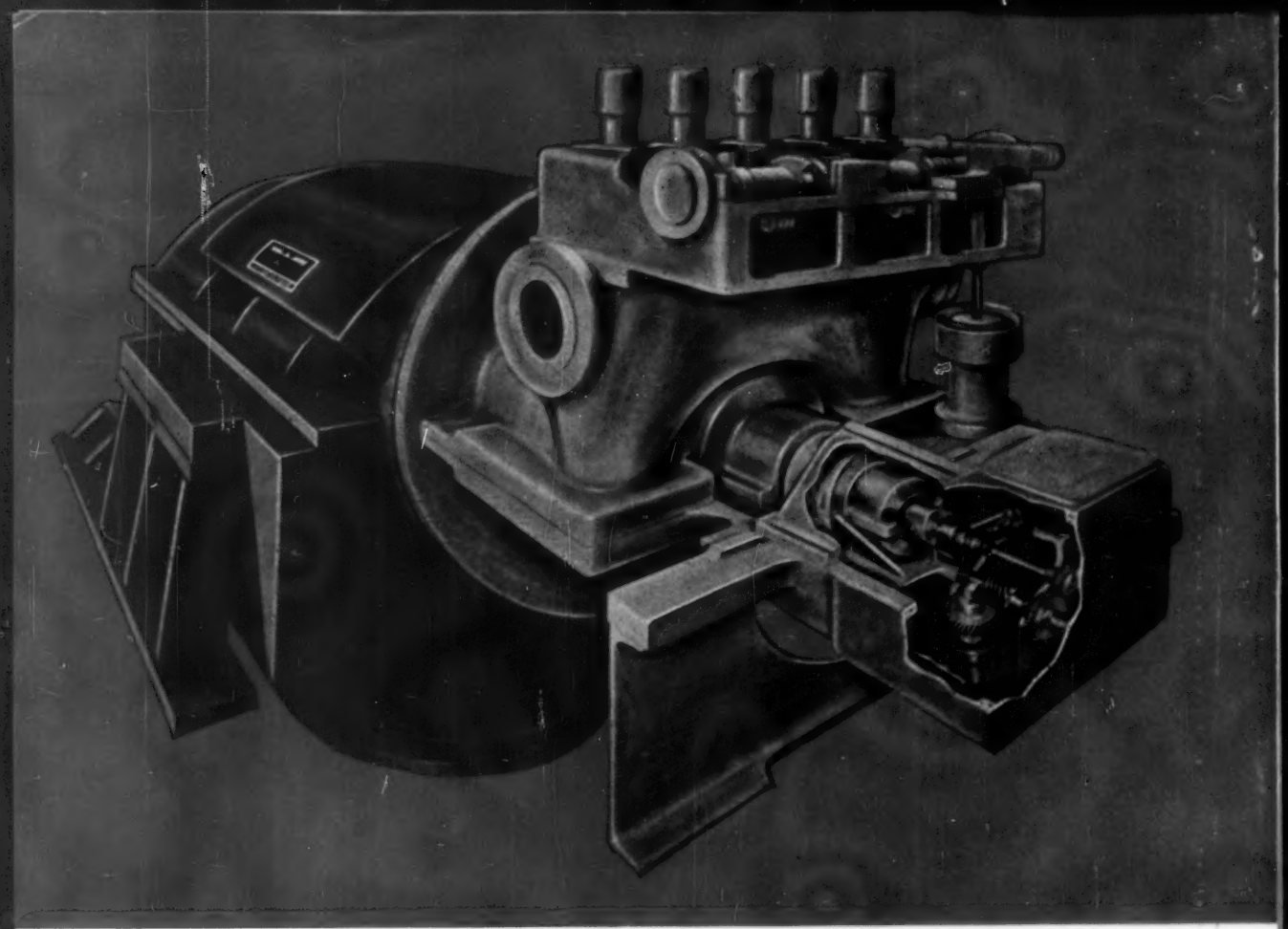
E-M

1110-TPA-1107

ELECTRIC MACHINERY MFG. COMPANY
MINNEAPOLIS 13, MINNESOTA

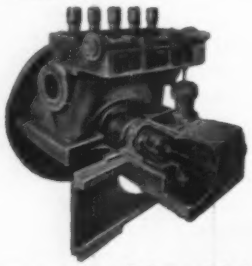
Specialists in making motors do
EXACTLY WHAT YOU WANT THEM TO

For more facts circle 202 on Reader Service card, p 103

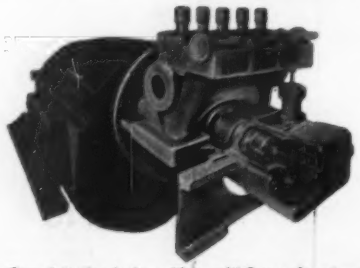


HOW WE ASSURE RELIABILITY IN A NEW DESIGN

1. Use an existing high-speed bearing case and a high capacity thrust bearing.



2. Add a high-pressure steam end of proved design with cam operated automatic nozzle control valves.



3. Complete the design with a multi-flow exhaust end.

HOW TO BUILD THE WORLD'S FASTEST 10,000 HP TURBINE

You can order this trail-blazing 15,000 rpm centrifugal compressor-drive turbine today with complete confidence because it makes use of components of proved reliability

Progress without sacrificing reliability is the goal of Worthington's Steam Turbine Division. How Worthington's creative engineering and advanced planning works to your advantage is illustrated by the steps taken in the continuing development of turbines of increasingly higher speeds:

1. Wherever possible use existing components proved reliable by years of operation.
2. Modify designs already in use in other high speed applications.
3. Thoroughly test these modifications to prove their reliability before field application.

Such advances in the turbine art bring new economies to high-speed, high-horsepower compressor drive applications. For information, call your nearest Worthington district office or write Worthington Corporation, Section 48-9, Wellsville, New York.

WORTHINGTON

For more facts circle 203 on Reader Service card, p 103